

AD-A038 676

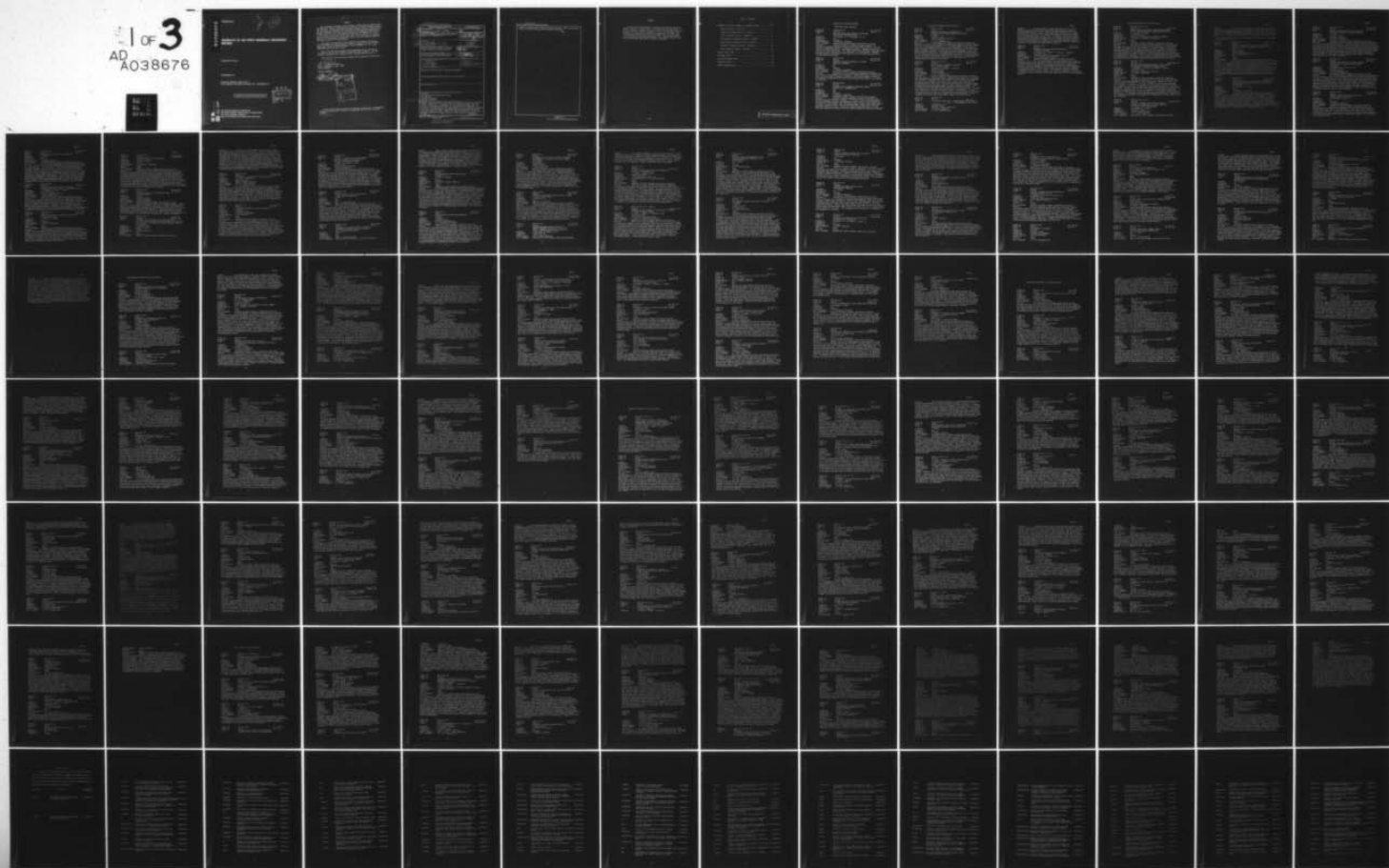
AIR FORCE MATERIALS LAB WRIGHT-PATTERSON AFB OHIO  
ABSTRACTS OF AIR FORCE MATERIALS LABORATORY REPORTS.(U)  
SEP 76 T G PURNHAGEN  
AFML-TR-76-111

F/G 5/2

UNCLASSIFIED

NL

1 OF 3  
AD A038676



ADA 038676

AFML-TR-76-111

*[Handwritten signature]* *(12)*

# ABSTRACTS OF AIR FORCE MATERIALS LABORATORY REPORTS

OPERATIONS OFFICE

SEPTEMBER 1976

TECHNICAL REPORT AFML-TR-76-111  
FINAL REPORT FOR PERIOD JANUARY 1975 - DECEMBER 1975

Approved for public release; distribution unlimited

DDC  
RECEIVED  
APR 27 1977  
*[Handwritten signature]* A

AD No. \_\_\_\_\_  
DDC FILE COPY

AIR FORCE MATERIALS LABORATORY  
AIR FORCE WRIGHT AERONAUTICAL LABORATORIES  
AIR FORCE SYSTEMS COMMAND  
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433



NOTICE

When Government drawings, specifications, or other data are used for any purposes other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.


This report was prepared by the Scientific and Technical Information Office (STINFO), Air Force Materials Laboratory, Wright-Patterson Air Force Base, Ohio, under job number 73810328. Tom G. Purnhagen, Lt. Col., USAF (AFML/DOC) was the project monitor.

This report has been reviewed by the Information Office (IO) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

  
TOM G. PURNHAGEN, Lt. Col., USAF  
Project Monitor

FOR THE COMMANDER

  
WARREN P. JOHNSON  
Chief, Operations Office

RTM		White Section	<input checked="" type="checkbox"/>
DOC		Self Section	<input type="checkbox"/>
UNANNOUNCED			
JUSTIFICATION			
BY			
DISTRIBUTION/AVAILABILITY CODES			
Dist.		AVAIL. AND OF SPECIAL	
A			

Copies of this report should not be returned unless return is required by security considerations, contractual obligations, or notice on a specific document.

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER AFML-TR-76-111	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) ABSTRACTS OF MATERIALS LABORATORY REPORTS. JANUARY 1975 - DECEMBER 1975	5. TYPE OF REPORT & PERIOD COVERED Final Technical Report. 1 January 1975 - December 1975	
7. AUTHOR(s) TOM G. PURNHAGEN, Lt. Col., USAF	8. CONTRACT OR GRANT NUMBER(s)	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Air Force Materials Laboratory (AFML/DO) Wright- Patterson Air Force Base, Ohio	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 73810328	
11. CONTROLLING OFFICE NAME AND ADDRESS Air Force Materials Laboratory (AFML/DO) Wright-Patterson Air Force Base, Ohio	12. REPORT DATE September 1976	
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	13. NUMBER OF PAGES 173	
	15. SECURITY CLASS. (of this report) UNCLASSIFIED	
16. DISTRIBUTION STATEMENT (of this Report)  Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Abstracts Air Force Materials Laboratory Reports Bibliography Materials Information Materials Research		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Technical reports published by the Air Force Materials Laboratory during the period 1 January 1975 - 31 December 1975 are abstracted herein. They are presented in groups corresponding to the divisions of the Laboratory. In addition to the abstract text, the report number, author, AFML project monitor, contractor, contract number, AFML project/task number, report date, and MIC accession numbers are given. Reports on research conducted by the Air Force Materials Laboratory personnel as well as that conducted on contract are included. (continued)		

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

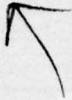
012320

4B

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

A number of indices are included in the report: subject (KWOC), AD accession number, AFML report number, contract number, contractor.



UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)



## FOREWORD

Technical reports published by the Air Force Materials Laboratory during the period 1 January 1975 - 31 December 1975 are abstracted herein. Reports on research conducted by Air Force Materials Laboratory personnel as well as those conducted on contract are included. The abstracts are separated into sections corresponding to the divisions of the laboratory with seven indices provided. The accession number cited with each abstract provides access to the document itself in the Air Force Materials Laboratory's document collection.



# TABLE OF CONTENTS

	PAGE
ABSTRACTS OF AIR FORCE MATERIALS LABORATORY REPORTS.....	1
Operations Office (AFML/DO).....	1
Advanced Development Division (AFML/LC).....	2
Metals & Ceramics Division (AFML/LL).....	4
Electromagnetic Materials Division (AFML/LP).....	22
Manufacturing Technology Division (AFML/LT).....	31
Nonmetallic Materials Division (AFML/MB).....	41
Systems Support Division (AFML/MX).....	65
SUBJECT (KWOC) INDEX.....	77
AD NUMBER INDEX.....	145
AFML REPORT NUMBER INDEX.....	151
CONTRACTOR INDEX.....	159
CONTRACT NUMBER INDEX.....	162

PRECEDING PAGE BLANK-NOT FILMED

# ABSTRACTS OF TECHNICAL REPORTS

## OPERATIONS OFFICE (AFML/DO)

REPORT NO: AFML-TR-74-257 AD A 013 914  
 ACCESS NO: 203,762 May 1975  
 TITLE: DATA ACQUISITION AND ANALYSIS OF LONG-TERM  
 THERMO-AGING DEGRADATION DATA  
 AUTHOR(S): D. Wisnosky, Lt. P. Cockerham, et al.  
 CONTRACT NO: N/A  
 CONTRACTOR: internal  
 PROJECT MONITOR: D. Wisnosky (AFML/DOC)  
 DIST. STATEMENT: Approved for public release; distribution unlimited.  
 ABSTRACT: Computer support for laboratory experimentation is becoming increasingly important in all types of scientific research. The more complex an experiment becomes, the greater the need for computer calculation, control, and data acquisition. This report describes a particular data acquisition instrument control application to an experiment in "Thermo-aging". Emphasis has been placed on installation and operation to aid in future applications of the data acquisition system.

REPORT NO: AFML-TR-75-75 AD A 017 860  
 ACCESS NO: 204,023 August 1975  
 TITLE: ABSTRACTS OF ACTIVE CONTRACTS, AIR FORCE  
 MATERIALS LABORATORY  
 AUTHOR(S): N/A  
 CONTRACT NO: N/A  
 CONTRACTOR: internal  
 PROJECT MONITOR: D. Wisnosky (AFML/DOC)  
 DIST. STATEMENT: Approved for public release; distribution unlimited  
 ABSTRACT: Abstracts of Air Force Materials Laboratory Contracts that were active on 05 February 1975 are reported. Each abstract entry provides the title of the contract, contractor, duration, AFML project engineer, objective and progress or approach in the case of new contracts where there is no progress to report yet.

REPORT NO: AFML-TR-75-123 AD A 019 454  
 ACCESS NO: 204,111 September 1975  
 TITLE: ABSTRACTS OF AF MATERIALS LABORATORY REPORTS,  
 JANUARY 1974 - DECEMBER 1974  
 AUTHOR(S): N/A  
 CONTRACT NO: N/A  
 CONTRACTOR: internal  
 PROJECT MONITOR: D. Wisnosky (AFML/DOC)  
 DIST. STATEMENT: Approved for public release; distribution unlimited.  
 ABSTRACT: Technical reports published by the Air Force Materials Laboratory during the period 1 January - 31 December 1974 are abstracted herein. They are presented in groups corresponding to the divisions of the Laboratory. In addition to the abstract text, the report number, author, AFML project monitor, contractor, contract number, AFML project/task number, report date, and AFMIC accession numbers are given. Reports on research conducted by the Air Force Materials Laboratory personnel as well as that conducted on contract are included.

ADVANCED DEVELOPMENT DIVISION (AFML/LC)

REPORT NO: AFML-TR-73-152 AD B 004 689  
 ACCESS NO: 69,611 May 1973  
 TITLE: ADVANCED DEVELOPMENT ON VULNERABILITY/  
 SURVIVABILITY OF ADVANCED COMPOSITE STRUCTURES  
 AUTHOR(S): H. Clark  
 CONTRACT NO: F33615-71-C-1414  
 CONTRACTOR: McDonnell Aircraft Corporation  
 PROJECT MONITOR: R. Neff (AFML/LC)  
 DIST. STATEMENT: U.S. Govt. Agencies Only  
 ABSTRACT: An experimental and analytical program was conducted to determine the effect of environmental and operational damage on composite empenage structure. The threshold strength, i.e., the preload stress at which ballistic impact will cause catastrophic failure was also established. It was determined that the threshold strength was lower than the residual strength of ballistically damaged unloaded composites. The study also provided considerable insight into repair methods for composites. The effectiveness of integrally bonded aluminum wire mesh in protecting boron and graphite/epoxy composites was also demonstrated on large subcomponent beams and a full scale horizontal tail. A 120-mesh aluminum coating was found to be effective against direct lightning strikes of 200 kA intensity with a discharge of 100 coulombs.

REPORT NO: AFML-TR-75-51 Vol.I AD B 006 906L  
 ACCESS NO: 203,825 May 1975  
 TITLE: LIFE ASSURANCE OF COMPOSITE STRUCTURES  
 VOL.I MOISTURE EFFECTS  
 AUTHOR(S): J. Halkias, E. McKague, J. Reynolds  
 CONTRACT NO: F33615-73-C-5104  
 CONTRACTOR: General Dynamics  
 PROJECT MONITOR: A. Davis (AFML/LC)  
 DIST. STATEMENT: U.S. Govt. Agencies Only  
 ABSTRACT: Volume I describes tests that were conducted to determine rates and extent of moisture absorption by graphite-epoxy composites. Procedures were developed for accelerating moisture exposures so that years of environmental service could be simulated within a few months. An empirical math model was developed which can predict moisture absorption behavior under realistic or accelerated exposure conditions. Tests were also conducted to determine whether aircraft flight conditions cause changes in moisture absorption behavior. These investigations show that graphite-epoxy composites absorb moisture until an equilibrium level is reached which is proportional to relative humidity. Simulated flight conditions do not cause significant drying of the laminates. In fact, brief exposures (4-5 minutes) to supersonic heating temperatures cause significant increases in the amount and rate of subsequent moisture absorption. Subsonic temperatures, however, cause no detectable change in diffusion behavior.

REPORT NO: AFML-TR-75-78  
 ACCESS NO: 69, 613 May 1975  
 TITLE: F-15 COMPOSITE WING VOL I - DEVELOPMENT AND TEST RESULTS  
 VOL II - DEVELOPEMENT AND TEST RESULTS  
 AUTHOR(S): A. Pedersen, et al  
 CONTRACT NO: F33615-71-C-1536  
 CONTRACTOR: McDonnell Aircraft Corporation  
 PROJECT MONITOR: D. Roselius (AFML/LC)  
 DIST. STATEMENT: U.S. Govt. Agencies Only



AFML/LC

**ABSTRACT:** An experimental F-15 wing containing a main torque box structure comprised mainly of boron/epoxy and graphite/epoxy is developed and demonstrated ready for flight. Good experimental correlations to design predicted values confirm adequate flutter speed margins and the wing's freedom from divergence instability. The composite wing design is 418 pounds lighter than the counterpart production metal wing. A noteworthy manufacturing accomplishment was the cocuring of the upper and lower sandwich cover skin assemblies. Economical machining/drilling techniques for boron/epoxy and graphite/epoxy laminates were demonstrated to consistently produce high tolerance, delamination free holes in boron/epoxy and graphite/epoxy laminates.

REPORT NO:	AFML-TR-75-113	AD A 018 745
ACCESS NO:	204,096	October 1975
TITLE:	RELIABILITY AND RISK ASSESSMENT METHODS AND REDUNDANT STRUCTURES	
AUTHOR(S):	J. McCarthy, O. Orringer, R. Peterson, K. Seppanen	
CONTRACT NO:	F33615-70-C-1131	
CONTRACTOR:	Aeroelastic and Structures Research Lab, MIT	
PROJECT MONITOR:	Lt. G. Hollingsworth (AFML/LC)	
DIST. STATEMENT:	Approved for public release; distribution unlimited.	
ABSTRACT:	The historical background of risk assessment activities concerning the USAF fleet is reviewed and the flaw-growth and wear-out approaches to material behavior are discussed to place the present work in perspective. A new definition of two categories of risk assessment probability calculation is proposed. The second category, which estimates risk due to strength degradation in an aging structure is shown to require accounting for mechanical redundancy if accurate assessments are to be made. A new probability modelling procedure is presented. The new procedure accounts for mechanical redundancy by combining a new generalization of Daniel's fiber bundle theory with matrix structural analysis methods.	



METALS AND CERAMICS DIVISION (AFML/LL)

REPORT NO: AFML-TR-72-102 PT III  
 ACCESS NO: 203,562 April 1975  
 TITLE: STRESS-CORROSION CRACKING OF METALLIC MATERIALS,  
 PT III, HYDROGEN ENTRY AND EMBRITTLEMENT IN STEEL  
 AUTHOR(S): M. Fontana, R. Staehle  
 CONTRACT NO: F33615-69-C-1258  
 CONTRACTOR: The Ohio State University Research Foundation  
 PROJECT MONITOR: C. Lynch, H. Kirkpatrick (AFML/LLN)  
 PROJECT NO: 7312  
 TASK NO: 731202  
 DIST. STATEMENT: Approved for public release; distribution unlimited.  
 ABSTRACT: The chemical environment and metallurgical structure play important roles in the entry of hydrogen into iron and steel. In particular, the effect of compounds of sulfur, arsenic, phosphorus, selenium and other elements, generally called "cathodic poisoners," is considered. Their effect is probably related to a perturbation of the surface layer of the metal, and this accelerates the hydrogen absorption kinetics significantly as the number of structural defects increases. The role of pH, electrochemical potential, stress, and temperature on the hydrogen entry kinetics is also considered. The literature regarding the stress corrosion cracking of high-strength steel is reviewed.

REPORT NO: AFML-TR-73-172  
 ACCESS NO: 202,433 September 1973  
 TITLE: FRACTURE TOUGHNESS, AGING BEHAVIOR, GRAIN GROWTH,  
 AND HARDNESS OF ALPHA-BETA TITANIUM ALLOYS  
 AUTHOR(S): I. Greenhut, E. Levine, H. Margolin, M. Young  
 CONTRACT NO: F33615-72-C-1529  
 CONTRACTOR: Polytechnic Institute of New York  
 PROJECT MONITOR: L. Bidwell, (AFML/LLM)  
 PROJECT NO: 7351  
 TASK NO: 735105  
 DIST. STATEMENT: Approved for public release; distribution unlimited.  
 ABSTRACT: The fracture toughness of Ti-5.25Al-5.5V-0.9Fe-0.5Cu was studied for equiaxed alpha-aged beta structures heat treated to produce 0.2% yield stresses of 180,000 psi. As grain increased  $K_Q$  was found to decrease then increase. A mechanism is proposed. The structure of Ti-6Al-2Sn-4Zr-6Mo was determined over a range of quenching and aging temperatures by x-ray electron microscopy. Hardness was correlated with structure as a function of aging time. Methods of revealing grain size in a two-phase  $\alpha$ -B titanium alloy have been examined and observations on beta grain growth in the presence of alpha have been carried out. The hardness of grain boundary alpha was studied as a function of the thickness of alpha and the hardness of the beta matrix in a Ti-5.25Al--5.5V-0.9Fe-.05Cu alloy.

REPORT NO: AFML-TR-73-247 Vol II  
 ACCESS NO: 202,045 September 1974  
 TITLE: PROGRAM TO IMPROVE THE FRACTURE TOUGHNESS  
 AND FATIGUE RESISTANCE OF ALUMINUM SHEET AND  
 PLATE FOR AIRCRAFT APPLICATIONS  
 AUTHOR(S): D. Thompson, R. Zinkham  
 CONTRACT NO: F33615-74-C-5060  
 CONTRACTOR: Reynolds Metals Company  
 PROJECT MONITOR: Lt. P. Blau (AFML/LLS)  
 DIST. STATEMENT: Approved for public release; distribution unlimited.

AFML/LL

ABSTRACT: The fatigue crack growth rate (FCGR) characteristics of a 7000 series and a 2000 series alloy were evaluated. The bulk of the work was carried out on thermomechanically aged (TMA) RX725 (Al-6Zn-2.5Mg-1.5Cu-.1Zr) and 2048 in the TMA and -T3E9 tempers respectively. Controls included commercial 7975-T6 and 2024-T3 and laboratory-produced 7475-T6 and -T73 and 2124-T351 and -T851.

The results showed a consistent FCGR advantage of RX725-TMA over 7075-T6 and of 2048-T3E9 over 2024-T3.

REPORT NO: AFML-TR-74-198 AD A 014 359  
ACCESS NO: 203,804 April 1975  
TITLE: RELIABILITY ASSESSMENT OF AIRCRAFT STRUCTURES  
BASED ON PROBABILISTIC INTERPRETATION OF THE SCATTER  
FACTOR  
AUTHOR(S): A. Freudenthal  
CONTRACT NO: F33615-74-C-5003  
CONTRACTOR: George Washington University  
PROJECT MONITOR: R. Donat (AFML/LLN)  
PROJECT NO: 7351  
TASK NO: 735106  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: The "scatter factor" S as used in fatigue design of aircraft is defined as the ratio between the location parameter (estimate) of the "population" of all aircraft, obtained from n full-scale tests, and the first failure in a fleet of m aircraft. Introducing the Third Asymptotic distribution of smallest values for the fatigue life of the population, this definition produces a Pareto-type distribution of the scatter-factor, on the basis of which S can be related to the number n and m and the reliability level R. Tables of S for different combinations of n, m, R and the "minimum fatigue life" are evaluated. Useful values of the scatter factor for different materials and purposes are suggested.

REPORT NO: AFML-TR-74-203 AD A 014 342  
ACCESS NO: 203,807 March 1975  
TITLE: A PRELIMINARY STUDY OF FATIGUE CRACK RETARDATION  
USING LASER INTERFEROMETRY TO MEASURE CRACK SURFACE  
DISPLACEMENTS  
AUTHOR(S): A. Grandt, Jr., W. Sharpe  
CONTRACT NO: N/A  
CONTRACTOR: internal  
PROJECT MONITOR: A. Grandt, Jr. (AFML/LLN)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: A laser interferometry technique is described which is capable of resolving crack surface displacements to a high degree of sensitivity (about 0.1 micron). The method provides continuous measurements of the free surface crack profile in metal specimens without being limited by rigid body displacements. Using the laser interferometry procedure to determine fatigue crack profiles in 2024-T851 aluminum specimens, it was possible to measure the load at which crack faces completely separate. These opening loads were correlated with peak tensile overloads and subsequent crack retardation. These results are discussed in terms of the Elber concept of fatigue crack closure.

REPORT NO: AFML-TR-74-214 AD A 008 781  
ACCESS NO: 203,507 October 1974  
TITLE: STRENGTH CHARACTERISTICS OF BORON ALUMINUM  
COMPOSITE SUBJECTED TO COMBINED STRESSES  
AUTHOR(S): R. Thomas  
CONTRACT NO: F33615-73-C-5026  
CONTRACTOR: Washington University  
PROJECT MONITOR: E. Joseph (AFML/LL)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: Quasi-static combined stress experiments were performed on 50 v/o unidirectional Al/B composites. The Failure Tensor Polynomial Criterion correlated the experimentally determined failure surface within empirical accuracy. This program has also shown that the compressive axial strength is significantly greater than the tensile axial strength. Combined axial and shear stress fatigue testing has been demonstrated and the results suggest that Al/B composites have good resistance to combined axial-shear fatigue. Preliminary exploration indicates that the stress path may have a significant influence on strength. Additional work in this area is desirable.

REPORT NO: AFML-TR-74-215 AD A 014 361  
ACCESS NO: 203,842 May 1975  
TITLE: NONDESTRUCTIVE TESTING OF DIFFUSION BONDED  
TITANIUM ALLOYS FOR ENGINE AND AIRFRAME  
COMPONENTS  
AUTHOR(S): J. Regalbuto, D. Gordon, et al.  
CONTRACT NO: F33615-72-C-1705  
CONTRACTOR: General Dynamics  
PROJECT MONITOR: J. Holloway (AFML/LLP)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: The development and evaluation of ultrasonic instrumentation for the nondestructive testing of diffusion bonded titanium alloy components is described. The fabrication of 600 diffusion bonded specimens containing international deficiencies such as voids, inclusions, lack of deformation, and grain size variations is described. Results are documented of the nondestructive evaluation of a large diffusion bonded titanium structure utilizing blue-etch-anodize, fluorescent penetrant, signal averaged pulse-echo, Delta-Scan, and variable tilt-multiple scan pulse-echo techniques. Defect data resulting from sectioning the large structure are documented.

REPORT NO: AFML-TR-74-224 AD A 005 701  
ACCESS NO: 203,344 November 1974  
TITLE: DYNAMIC COMPRESSIVE STRAIN RATE TESTS ON  
SEVERAL GRADES OF BERYLLIUM  
AUTHOR(S): T. Nicholas, M. Sever  
CONTRACT NO: N/A  
CONTRACTOR: internal  
PROJECT MONITOR: T. Nicholas (AFML/LLN)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: Results of static and dynamic compression tests on several grades of beryllium and lockalloy are presented. A split Hopkinson pressure bar system, used to generate data at strain rates up to  $10^3 \text{ sec}^{-1}$ , is described in detail. Stress-strain curves show several different grades of beryllium to have a moderate amount of strain rate sensitivity in compression in the plastic region.



AFML/LL

REPORT NO: AFML-TR-74-236 AD A 014 795  
ACCESS NO: 203,824 May 1975  
TITLE: BORON ALUMINUM TITANIUM HYBRID COMPOSITES  
AUTHOR(S): E. Joseph  
CONTRACT NO: N/A  
CONTRACTOR: internal  
PROJECT MONITOR: E. Joseph (AFML/LLS)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: Roll diffusion bonded tapes of boron-aluminum were inter-leaved with foils of commercial pure and alloyed titanium and diffusion bonded into plate material. Tensile testing of both longitudinal and transverse specimens indicated a very small drop in longitudinal strength and a dramatic increase in transverse strength to 48.6 ksi and 67 ksi for the Ti-75A and Ti-6Al-4V hybrid, respectively, for annealed unidirectional composites. These transverse strength increases were considerably in excess of rule of mixtures predictions. Metallographic examination of representative material indicated well spaced and adequately bonded material. Direct comparison with similarly bonded unidirectional and cross-plyed boron-aluminum plate indicated that, when considering both mechanical properties and composite cost, considerable advantage could be gained through the use of the hybrid composite studied.

REPORT NO: AFML-TR-74-241  
ACCESS NO: 203,852 January 1975  
TITLE: PRACTICAL SENSITIVITY LIMITS OF PRODUCTION  
NONDESTRUCTIVE TESTING METHODS IN ALUMINUM AND STEEL  
AUTHOR(S): H. Southward, N. Steele, P. Torelli  
CONTRACT NO: F33615-72-C-2202  
CONTRACTOR: Boeing Commercial Airplane Co.  
PROJECT MONITOR: F. Mullins (AFML/LLP)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: This report describes the work accomplished under an 18 month program conducted to evaluate the sensitivity capabilities of current state-of-the-art nondestructive inspection methods. The methods include magnetic particle, penetrant, eddy-current, ultrasonic, and radiographic. These capabilities were demonstrated in response to varied surface flaws and were statistically defined in terms of probability and confidence of detection. This was accomplished with differing specimen configurations in two representative aircraft structural alloys and for both laboratory and production inspections.

REPORT NO: AFML-TR-74-252 AD A 011 647  
ACCESS NO: 203,675 April 1975  
TITLE: NOTCH TENSILE STRENGTH OF ADVANCED STRUCTURAL  
GRADES OF BERYLLIUM  
AUTHOR(S): T. Nicholas, G. Atkins  
CONTRACT NO: N/A  
CONTRACTOR: internal  
PROJECT MONITOR: T. Nicholas (AFML/LLN)  
PROJECT NO: 7351  
TASK NO: 735106  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: Room temperature notch tensile of two advanced structural grades of beryllium was determined at quasi-static and high strain rates. Results on P-1 hot isostatically pressed and S-65 hot pressed beryllium indicated that the ductility ratio of Gerard provides a more reasonable approach to design allowables for these materials than tensile elongations for tensile loading in the presence of notches. Ductility ratios of .138 for P-1 and .058 for S-65 were found to represent these materials adequately for values of the theoretical elastic stress concentration factor less than five.



AFML/LL

REPORT NO: AFML-TR-74-255  
ACCESS NO: 203,457  
TITLE: GRAIN REFINEMENT OF TITANIUM ALLOYS  
AUTHOR(S): M. Buczek, G. Hall  
CONTRACT NO: F33615-73-C-5106  
CONTRACTOR: RMI Co.  
PROJECT MONITOR: M. Greenfield (AFML/LLN)  
PROJECT NO: 7351  
TASK NO: 735105  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: The objective of this program was to determine the optimum amounts of yttrium added either as the oxide or element for grain refinement to commercial Ti-6Al-4V and Ti-38-6-44 titanium alloys and establish the effects on subsequent mechanical behavior and sonic inspectability. The properties of cast 8-inch diameter ingots as well as 3-inch bar processed from these ingots were evaluated at yttrium data were obtained on alloys containing 0.03 percent yttrium. At this level, significant grain refinement was not observed in Ti-38-6-44 although improved sonic inspectability, higher transverse ductility and improved stress-corrosion resistance were observed. At the same 0.03 percent yttrium content, the recrystallized Ti-6Al-4V beta grain size was reduced and improved sonic inspectability and ductility were obtained in wrought and cast products.

AD A 008 532  
November 1974

REPORT NO: AFML-TR-74-265  
ACCESS NO: 203,776  
TITLE: OXIDATION BEHAVIOR OF TITANIUM ALLOYS UNDER HIGH HEATING RATES  
AUTHOR(S): J. Wolf  
CONTRACT NO: F33615-73-C-5151  
CONTRACTOR: Clemson University  
PROJECT MONITOR: S. Lyon (AFML/LLM)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: The initial stages of reaction of unalloyed titanium, Ti-6Al-4V, Ti8Mn, and -111 titanium alloy specimens with oxygen, nitrogen, and atmospheres bearing these gases has been studied over the temperature range from 800° to 1300° C. The kinetics of these reactions were analyzed for specimens subjected to linear heating rates in the range from 0.5° to 100° C/s. Mathematical techniques were devised for modeling: 1) the oxygen uptake by unalloyed titanium during heating, and 2) the deposition of the chemical heat of reaction into oxidizing substrates.

AD A 013 880  
April 1975

REPORT NO: AFML-TR-74-269  
ACCESS NO: 202,168  
TITLE: EXPLORATION OF STATISTICAL FATIGUE CHARACTERISTICS OF 0.063 - INCH MILL-ANNEALED Ti-6Al-4V SHEET AND 0.050-INCH HEAT-TREATED 17-7 PH STEEL SHEET UNDER SIMULATED FLIGHT-BY-FLIGHT LOADING  
AUTHOR(S): J. Butler, D. Rees  
CONTRACT NO: F33615-72-C-2003  
CONTRACTOR: Boeing  
PROJECT MONITOR: R. Donat (AFML/LLN)  
PROJECT NO: 7351  
TASK NO: 735106  
DIST. STATEMENT: Approved for public release; distribution unlimited.

AD A 011 717  
January 1975

**ABSTRACT:** A total of 17 mill-annealed Ti-6Al-4V 0.063-in. sheet and 14 heat-treated 17-7PH steel 0.050-in. sheet, unique multidetail specimens were fatigue tested under a flight-by-flight loading spectrum to develop a data base for investigating the statistical materials/structures fatigue failure characteristics of these two alloys. In several cases, test specimens of the relatively hard 17-7PH steel fractured before initiated cracks or initial flaws were detected. At open hole structural simulators, detected fatigue cracks were removed by oversizing. The initiation data were examined by maximum likelihood methods for both log-normal and Weibull distributional representation. At a 0.50 reliability level, the results did not show an obvious advantage for either distribution, but on increased levels of reliability, the Weibull distribution was a significantly more conservative simulation of the test data, which showed less variability than that estimated in a previous study.

REPORT NO: AFML-TR-74-273 AD B 005 585 L  
 ACCESS NO: 203,714 January 1975  
 TITLE: BASIC RESEARCH ON LASER PLUME CHARACTERIZATION  
 AUTHOR(S): F. Greene, G. Radolovich  
 CONTRACT NO: F33615-73-C-5121  
 CONTRACTOR: Midwest Research Institute  
 PROJECT MONITOR: Capt. A. Grandt (AFML/LLN)  
 DIST. STATEMENT: U.S. Govt. Agencies Only  
**ABSTRACT:** An investigation of the interaction of militarily relevant materials with fluxes of 10.6  $\mu\text{m}$  radiation between  $10^2$  and  $10^4$  watts/cm<sup>2</sup> is being carried out. Molecular beam mass spectrometry has been adapted to the sampling of laser plumes formed at atmospheric pressure. A fast data acquisition system has been developed in which the scan of a quadrupole mass spectrometer is synchronized with the molecular beam chopper. Complete spectra can be obtained which have time resolution of the order of 10 msec or better and which include phase sensitive detection. Photography and other techniques have also been used. Preliminary measurements were also made on plumes formed by the irradiation of Plexiglas<sup>TM</sup> and a graphite-epoxy composite material.

REPORT NO: AFML-TR-74-276 AD A 014 352  
 ACCESS NO: 203,811 May 1975  
 TITLE: SOME GENERAL PROGRAMS FOR DESK TOP COMPUTERS  
 AUTHOR(S): J. Wagner  
 CONTRACT NO: F33615-73-C-5084  
 CONTRACTOR: University of Cincinnati  
 PROJECT MONITOR: O. Srp (AFML/LLS)  
 PROJECT NO: 7351  
 TASK NO: 735101  
 DIST. STATEMENT: Approved for public release; distribution unlimited.  
**ABSTRACT:** A library of four data analysis programs for the H-P 9820A are presented with operational procedures and complete listings. The library includes a general least squares curve fitting program for polynomials up to degree six with automatic plotting of both the data, fitted curve, and coefficients. In addition a data and function plot program is included which enables efficient plotting of analytic functions and data with control of axis location, labels, and data symbols. Thirdly, a linear regression program is developed which includes a complete statistical analysis of the fitted line. Finally, a general digitizing program is listed which enables quick conversion of graphical information into tabular data without special orientation of the digitizing surface.

AFML/LL

REPORT NO: AFML-TR-74-280 AD A 009 172  
ACCESS NO: 203,522 January 1975  
TITLE: THE ROLE OF TRANSIENT SPECTRUM AND DAMPING  
ANALYSIS IN ASSESSING THE STRENGTH OF  
POLYMERIC ADHESIVE METAL BONDING  
AUTHOR(S): G. Curtis, A. Joinson, P. Lloyd  
CONTRACT NO: AFOSR-73-2523A  
CONTRACTOR: Harwell Industrial Research  
PROJECT MONITOR: F. Mullins (AFML/LLP)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: This report describes the derivation of an acoustic impact testing facility and some results that have been obtained using it. The primary task has been to examine what acoustic phenomena associated with the response to impact of an adhesively bonded joint relate to the strength of the joint. A "first look" system employing a 40  $\mu$  sec contact time impactor, a broadband polymeric foil transducer and a PDP8/I on-line computer has been used to identify the parameters of interest and the most efficient analysis scheme. The analysis has centered around the computation of the fast Fourier transform of the impact response to obtain frequency response spectra and damping information. Initial results using the "first look" system have shown that the presence of artificial defects in rectangular bars can be detected.

REPORT NO: AFML-TR-74-282 AD A 015 001  
ACCESS NO: 203,819 May 1975  
TITLE: A STRESS INTENSITY FACTOR CALIBRATION FOR  
CORNER FLAWS AT AN OPEN HOLE  
AUTHOR(S): J. Snow  
CONTRACT NO: N/A  
CONTRACTOR: AFIT  
PROJECT MONITOR: Capt. A. Grandt (AFML/LLN)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: This study was an experimental stress intensity factor calibration of a part-thru, corner flaw at an open hole. The fatigue crack growth test was used to investigate corner flaws at holes in polymethylmethacrylate plates loaded in uniform, cyclic tension. It was found that a frequency of 1 or 2 cps could be used for fatigue crack growth in PMMA. In general, this study demonstrated lower stress intensity at the hole and higher stress intensity at the surface for larger crack sizes when compared to other researchers. It was concluded that fatigue crack growth rate testing with PMMA is a useful method of obtaining stress intensity factor calibrations for complex, three-dimensional problems where no exact solutions exist.

REPORT NO: AFML-TR-74-283 AD A 015 002  
ACCESS NO: 203,820 May 1975  
TITLE: DETERMINATION OF STRESS INTENSITY FACTOR FOR  
COLD-WORKED FASTENER HOLES IN 7075 ALUMINUM  
USING THE CRACK GROWTH METHOD  
AUTHOR(S): Cathey, W.  
CONTRACT NO: N/A  
CONTRACTOR: AFIT  
PROJECT MONITOR: Capt. A. Grandt (AFML/LLN)  
DIST. STATEMENT: Approved for public release; distribution unlimited.



**ABSTRACT:** Stress intensity factor calibrations were obtained for thru-the-thickness flaws emanating from cold-worked fastener holes in 7075-T6 aluminum alloy plate using the fatigue crack growth method. Cracks were periodically photographed to determine crack growth rate using a 35 mm camera actuated by a digital counter. Tests were conducted in laboratory air with constant amplitude loading, 30 Hz frequency, and R-factor=0.05. The J.O. King sleeved cold-working process was used with a nominal diametral interference of 0.012 in. Open-hole specimens were tested at 16 KSI and 40 KSI remote stress. K calibrations for open cold-worked holes were in agreement with Grandt's linear superposition solution. Pin-loaded cold-worked holes, tested using a 2000 lb. load transferred through a 0.25 in. pin, showed a twentyfold increase in fatigue life.

REPORT NO: AFML-TR-75-1 AD A 018 127  
 ACCESS NO: 204,036 July 1975  
 TITLE: LOW CYCLE FATIGUE CRACK INITIATION STUDY  
 IN RENE' 95  
 AUTHOR(S): M. Menon, W. Reimann  
 CONTRACT NO: N/A  
 CONTRACTOR: internal  
 PROJECT MONITOR: M. Menon, W. Reimann (AFML/LLN)  
 PROJECT NO: 7351  
 TASK NO: 735106  
 DIST. STATEMENT: Approved for public release; distribution unlimited.  
 ABSTRACT: A microstructural study of fatigue deformation and cracking was conducted on Rene' 95 which is a thermomechanically processed superalloy developed for use as disks in advanced gas turbine engines. It was found that the deformation occurred very homogeneously throughout the material. This is believed to be due to the slip dispersive effect of the substructure in the warm worked grains and the very small size of the necklace grains. The study also showed that the number of load cycles to produce crack initiation can be strongly affected by brittle constituents of the microstructure, such as MC carbides. It was found that the specimens that had shorter lives were characterized by MC carbide cracking at the site of the crack initiation, whereas those which had longer lives under the same conditions of loading and temperature were characterized by only slip band cracking with no evidence of MC carbide cracking or decohesion in influencing the initiation.

REPORT NO: AFML-TR-75-2 AD A 013 915  
 ACCESS NO: 203,774 May 1975  
 TITLE: MODAL ANALYSIS OF LINEAR NON-CONSERVATIVE SYSTEMS  
 AUTHOR(S): R. Adkins  
 CONTRACT NO: F33615-72-C-2113  
 CONTRACTOR: Universal Technology Corp.  
 PROJECT MONITOR: Dr. J. Henderson (AFML/LLN)  
 DIST. STATEMENT: Approved for public release; distribution unlimited.  
 ABSTRACT: Modal methods for analyzing continuous, linear, nonconservative vibrating systems are developed and applied. Both viscous and hysteretic damping are considered and the damping distributions are arbitrary such that the normal modes of the corresponding undamped system will not uncouple the equations of motion of the nonconservative or damped system. Analytical and graphical results are presented for the special case of a pinned-pinned beam with a viscous or hysteretic damping unit at the center of the beam. These results show the uncoupled vibration modes, and the amplitude and phase variation along the beam for uniform harmonic forcing. The results of this investigation are contrasted to the modal methods for conservative systems and it is recommended that non-conservative systems be considered the general vibration problem.



AFML/LL

REPORT NO: AFML-TR-75-9 AD A 015 894  
ACCESS NO: 203,881 July 1975  
TITLE: DEVELOPMENT OF HOT ISOSTATIC PRESSING TECHNIQUES  
FOR PRODUCING HIGH QUALITY BILLET FROM TITANIUM  
ALLOY POWDER  
AUTHOR(S): G. Friedman  
CONTRACT NO: F33615-73-C-5092  
CONTRACTOR: Nuclear Metals, Inc.  
PROJECT MONITOR: A. Adair (AFML/LLM)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: The contract portion of this program demonstrated the feasibility of producing Ti-6Al-6V-2Sn powder by two different processes. Starting with bar containing 700 to 800 ppm oxygen, hydride dehydride (HD) powder was produced containing 700 to 1200 ppm oxygen. Using input bar from the same heat of metal, powder containing 500 to 800 ppm oxygen was made by the Rotating Electrode Process (REP). Room-temperature-consolidated HD powder and loose REP powder were consolidated by hot isostatic pressing (HIP) under a series of conditions covering 1/2 to 4 hours, 3,750 to 15,000 lb./inch<sup>2</sup>, and temperatures 75°F below and above the beta transus. The program results demonstrate that useful engineering properties can be obtained via simple P/M processing, and without subsequent hot working. Still higher properties are obtained after the HIP billets are forged.

REPORT NO: AFML-TR-75-16 AD A 015 831  
ACCESS NO: 203,880 August 1975  
TITLE: GROWTH OF MULTICOMPONENT COMPOSITES FROM THE MELT  
AUTHOR(S): K. Young, E. Dunn, et.al.  
CONTRACT NO: F33615-71-C-1374  
CONTRACTOR: M.I.T.  
PROJECT MONITOR: Capt. Dunco (AFML/LLM)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: An experimental investigation of interface stability during plane front solidification of the two phase  $\alpha$  plus  $\beta$  region of the Al-Cu-Ni system has been conducted. Further experimental work has been conducted on the effects of shape and direction variations on both the binary Al-Cu and ternary Al-Cu-Ni eutectic in-situ composites. A theory is given which relates the composition of interdendritic "eutectic" forming during unidirectional solidification to solidification variables. This theory shows that the composition of the solid freezing from the interdendritic liquid is not equal to the eutectic composition but is exactly equivalent to the composition of the alloy which would just grow with a planar front at the same growth rate and temperature gradient.

REPORT NO: AFML-TR-75-24 AD A 013 881  
ACCESS NO: 203,736 February 1975  
TITLE: ADAPTIVE NONLINEAR SIGNAL PROCESSING FOR  
CHARACTERIZATION OF ULTRASONIC NDE WAVEFORMS,  
TASK I: INFERENCE OF FLATBOTTOM HOLE SIZE  
AUTHOR(S): A. Mucciardi, R. Shankar, et.al.  
CONTRACT NO: F33615-74-C-5122  
CONTRACTOR: Adaptronics, Inc.  
PROJECT MONITOR: Dr. M. Buckley (AFML/LLP)  
DIST. STATEMENT: Approved for public release; distribution unlimited.

AFML/LL

ABSTRACT: The overall objective of this first work task was to demonstrate the feasibility of adaptive nonlinear signal processing techniques, from cybernetics, and bionics, applied to characterization of ultrasonic nondestructive testing (UNDT) waveforms for accurate inferences of flat-bottom sizes. Maximum amplitude of the pulse echo time waveform was not found to be a discriminating parameter when the transducer and/or transmission medium was changed.

REPORT NO: AFML-TR-75-30  
ACCESS NO: 203,845 April 1975  
TITLE: EFFECT OF OMEGA PHASE ON SELECTED PROPERTIES  
OF BETA III TITANIUM ALLOY  
AUTHOR(S): F. Froes, R. Malone, et.al.  
CONTRACT NO: F33615-71-C-1266  
CONTRACTOR: Colt Industries/Crucible, Inc.  
PROJECT MONITOR: R. Geisendorfer, S. Fujishiro (AFML/LLS)  
PROJECT NO: 7351  
TASK NO: 735105  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: The heat treatable beta alloys possess an outstanding combination of properties and have shown promise for a number of applications in the aerospace industry. Utilization, however, has been somewhat limited by a low elastic modulus:density ratio. Two approaches to increase the elastic modulus, increasing the proportion of high modulus phases and reducing the mean free path in the low modulus phase, were investigated using a number of thermo-mechanical processing and aging sequences and fine structure analysis. The results show that the elastic modulus can be increased by (1) an increase in the proportion of the high modulus alpha phase, (2) judicious increase in the amount of omega, and (3) an increase in the molybdenum content of the beta phase. There was no increase in modulus with a decrease in the mean free path in the beta material.

REPORT NO: AFML-TR-75-41, Vol. I and II  
ACCESS NO: 203,925 September 1975  
TITLE: RESEARCH ON DEEP HARDENING TITANIUM ALLOY FOR LARGE  
AIRFRAME STRUCTURAL MEMBERS  
AUTHOR(S): F. Froes, R. Malone, V. Petersen, et.al.  
CONTRACT NO: F33615-71-C-1525  
CONTRACTOR: Colt Industries/Crucible, Inc.  
PROJECT MONITOR: J. Hall, M. Greenfield (AFML/LLM)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: This is the final technical report of a contract to develop a titanium alloy capable of being hardened in section sizes significantly greater than currently available while retaining adequate toughness and tensile ductility. Work was carried out in three successive phases: Phase I in which the hardening potential at the center of a six-inch section was defined for sixty alloy compositions; Phase II in which the detailed evaluation of tensile properties and fracture toughness data of aged samples led to development of characteristic alloy trend lines for the ten most promising alloys; and finally, Phase III in which three alloys - alloy 334 (10Mo-6Cr-2.5Al), 227 (7Mo-4Cr-2.5Al), and 253 (10Mo-8V-2.5Al) - were scaled up as 500 lb. ingots.

AFML/LL

REPORT NO: AFML-TR-75-43  
ACCESS NO: 203,885  
TITLE: EFFECTS OF PURITY AND PROCESSING ON THE  
EXFOLIATION CORROSION BEHAVIOR OF 7X75  
ALUMINUM PLATE  
AUTHOR(S): Lt. P. Blau  
CONTRACT NO: N/A  
CONTRACTOR: internal  
PROJECT MONITOR: Lt. P. Blau (AFML/LLS)  
PROJECT NO: 7351  
TASK NO: 735105  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: The effect of varying iron and silicon content on the  
exfoliation corrosion behavior of two 7X75 type wrought aluminum alloys was  
investigated using the ASTM "EXCO" test. One series of alloy plates was basically  
the composition of 7475 with total iron and silicon varying in five steps between  
0.03 and 0.31 weight percent. The other series contained Zr in place of Cr in  
the basic composition, and had comparable variation in iron and silicon content.  
Test results showed that in general, Fe and Si content had no significant effect  
on exfoliation resistance in either temper or alloy series. Corrosive attack on  
the TMP coupons was more uniform than on the T651 coupons. Long subsurface  
cracks were observed in the T651 coupons. Machined sides of TMP coupons showed  
almost no attack, while those of the T651 coupons pitted. The depth of attack was  
about 1.5 times greater on the rolled surfaces of the T651 coupons compared to the  
TMP coupons. End-grain attack depth of T651 coupon sides was three times that of  
TMP coupon sides.

AD A 015 728  
July 1975

REPORT NO: AFML-TR-75-50  
ACCESS NO: 201,790  
TITLE: LOW-TEMPERATURE LARGE-AREA BRAZING OF TITANIUM  
STRUCTURES  
AUTHOR(S): R. Wells  
CONTRACT NO: F33615-73-C-5161  
CONTRACTOR: Northrop Corp.  
PROJECT MONITOR: G. Metzger (AFML/LLM)  
PROJECT NO: 7351  
TASK NO: 73510222  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: Various brazing filler metals were identified and brazing  
processes established for producing large-area damage-tolerant laminates of  
Ti-6Al-4V, Ti-6Al-6V-2Sn, and Ti-3Al-8V-6Cr-4Mo-4Zr for service between  
227°K and 422°K. Low melting-temperature filler metals were identified to permit  
the fabrication of laminates in the STA condition. Brazing filler metals were  
screened based upon their flow temperature and behavior, lap shear strength, bend  
deflection, and corrosion resistance. The most attractive brazing filler metals  
were aluminum brazing sheet 22 and alloys from the Al-Cu-Ag system. The brazing  
sheet was placed between the lamina and the Al-Cu-Ag alloys were placed alongside  
the lamina and flowed into the joints. The results of this program indicated that  
damage tolerant titanium structures can be produced in the STA condition with  
excellent damage tolerant properties in the crack arrest orientation and with no  
reduction in properties in the crack divider orientation. Considering properties  
and producibility, the brazing filler metal 22 is the most attractive system for  
producing these laminates.

AD A 015 860  
June 1975



AFML/LL

REPORT NO: AFML-TR-75-52  
ACCESS NO: 203,844  
TITLE: EFFECT OF PLASTIC PRESTRAIN ON THE TENSILE STRAIN TO FAILURE OF BERYLLIUM  
AUTHOR(S): T. Nicholas  
CONTRACT NO: N/A  
CONTRACTOR: internal  
PROJECT MONITOR: T. Nicholas (AFML/LLN)  
PROJECT NO: 7351  
TASK NO: 735106  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: Results of tensile tests on specimens of CIP/HIP P-1 beryllium previously prestressed into the plastic range are presented. Two types of prior deformation are considered, a plastic precompression and a plastic pretension followed by plastic compression. Data from tests involving levels of prestress between 40 and 55 ksi show no reduction in the uniaxial tensile strain to failure as a result of prior plastic deformations as high as one percent. An increase in tensile flow stress is observed for the precompressed specimens.

AD A 015 729  
June 1975

REPORT NO: AFML-TR-75-54  
ACCESS NO: 203,822  
TITLE: INSTRUMENTED IMPACT TESTING USING A HOPKINSON BAR APPARATUS  
AUTHOR(S): T. Nicholas  
CONTRACT NO: N/A  
CONTRACTOR: internal  
PROJECT MONITOR: T. Nicholas (AFML/LLN)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: A technique for conducting instrumented Charpy impact tests using a Hopkinson bar is presented. Data for three grades of beryllium covering a range in impact velocities from 20 to 200 in/sec. are obtained in the form of load deflection curves from which maximum load, maximum deflection, and total energy are obtained. Results show good agreement with data on identical materials obtained from an instrumented impact test at 54 in/sec. and from a standard Charpy impact machine at 135 in/sec. The advantages and limitations of the Hopkinson bar apparatus are discussed.

July 1975

REPORT NO: AFML-TR-75-57  
ACCESS NO: 204,059  
TITLE: THE EFFECTS OF REST-TIME ON FATIGUE CRACK RETARDATION AND OBSERVATIONS  
AUTHOR(S): W. Sharpe, Jr., D. Corbly, A. Grandt, Jr.  
CONTRACT NO: N/A  
CONTRACTOR: internal  
PROJECT MONITOR: D. Corbly (AFML/LLN)  
PROJ. NO: 7351  
TASK NO: 735106  
DIST. STATEMENT: Approved for public release; distribution unlimited.

AD A 018 635  
August 1975

AFML/LL

ABSTRACT: Increasing the rest-time of the specimens had the effect of slightly reducing the crack retardation as measured on the specimen surface. Crack opening loads measured on the specimen surface were found to increase with application of an overload and then decrease to the original value when the specimen was allowed to rest at zero load, while opening loads measured through the sample by the ultrasonic method did not vary significantly with peak loads or rest-times. Varying specimen thickness between 0.64 and 2.54 cm had little effect on surface-measured retardation or opening loads. The relationship between applied load and crack surface displacement as measured by ultrasonics varied significantly with specimen thickness.

REPORT NO: AFML-TR-75-60 AD A 019 750  
ACCESS NO: 204,104 June 1975  
TITLE: EXPLORATORY DEVELOPMENT OF IMPROVED CUTTING  
TOOLS FOR TITANIUM  
AUTHOR(S): E. Rudy  
CONTRACT NO: F33615-71-C-1385  
CONTRACTOR: Oregon Graduate Center  
PROJECT MONITOR: Dr. R. Ruh  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: Substoichiometric WC-Ni sintered carbide cutting tools, optionally doped with small quantities of selected carbonitrides and carbides for grain size control, show significantly improved resistance to localized crater wear over conventional C-2 and C-3 grade carbides in turning Ti6 Al4V alloy, at about equivalent flank wear resistance. The best performing alloys are those with a dual grain structure of respectively 1 to 2  $\mu$  and 6 to 10  $\mu$  tungsten carbide, binder contents between 16 to 9 percent by weight, and carbon deficiencies corresponding closely to the borderline of  $\eta$ -carbide formation. Armor penetration tests with unjacketed projectiles yielded good results with the cast alloys, while tests using cemented carbides were inconclusive.

REPORT NO: AFML-TR-75-84 AD A 020 283  
ACCESS NO: 204,112 November 1975  
TITLE: CRACK PROPAGATION CHARACTERISTICS IN THREE  
DEEP HARDENABLE TITANIUM ALLOYS  
AUTHOR(S): P. Bania  
CONTRACT NO: N/A  
CONTRACTOR: internal  
PROJECT MONITOR: P. Bania (AFML/LLS)  
PROJECT NO: 7351  
TASK NO: 735105  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: Three deep-hardenable grade titanium alloys have been evaluated for fatigue crack propagation characteristics. While a slight difference was noted in transverse/longitudinal orientations, no difference was detected from center to edge in 6" diameter forging billets. Stress corrosion cracking resistance was judged to be adequate for the chromium containing alloys and excellent for the chromium free alloy. Fractographic analysis revealed that an apparently brittle phase was contributing to fracture. This phase was indirectly identified as a boride containment.

AFML/LL

REPORT NO: AFML-TR-75-95 AD A 016 473  
ACCESS NO: 203,896 July 1975  
TITLE: DEFORMATION MODE OF VOID-GROWTH AND  
COALESCENCE IN THE PROCESS OF DUCTILE FRACTURE  
AUTHOR(S): S. Oh, S. Kobayashi  
CONTRACT NO: F33615-72-C-1645  
CONTRACTOR: University of California  
PROJECT MONITOR: V. DePierre (AFML/LLM)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: The objective of this investigation was to develop a fracture  
criterion applicable to the prediction of the occurrence of cracks in metal-working  
processes. A model for large void growth was proposed, and the deformation mode  
was calculated by the elastic-plastic finite-element method. The results of the  
calculation showed the formation of a shear band between large voids. The proposed  
fracture criterion is that the growth and coalescence of small voids along this  
shear band is the final process of fracturing. The fracture strain was estimated  
for a material by applying the McClintock analysis to small void coalescences.  
The proposed model offers an explanation for some important aspects of experimental  
observations of ductile fracture.

REPORT NO: AFML-TR-75-100 AD A 019 518  
ACCESS NO: 204,092 September 1975  
TITLE: FRACTURE TOUGHNESS AND AGING BEHAVIOR OF  
ALPHA-BETA TITANIUM ALLOYS  
AUTHOR(S): H. Margolin, E. Levine, M. Young, et al.  
CONTRACT NO: F33615-72-C-1529  
CONTRACTOR: Polytechnic Institute of New York  
PROJECT MONITOR: Dr. L. Bidwell (AFML/LLM)  
PROJECT NO: 7351  
TASK NO: 735105  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: Fracture toughness  $K_Q$  was studied as a function of micro-  
structure for alloy #2, Ti-5.25 Al-5.5V-0.9Fe-0.5Cu, at a y.s. of 180 Ksi  
(1241 MN/m<sup>2</sup>) and for Ti-6Al-2Sn-4Zr-6Mo at a y.s. of 160 Ksi (1100 MN/m<sup>2</sup>), with  
emphasis on alloy #2. For equiaxed structures  $K_Q$  initially decreased with  
increasing grain size (G.S.) and subsequently increased. Analysis of Widmanstätten  
plus grain boundary  $q_c$  data separated out the G.S. contribution which was attri-  
buted to increased plasticity when the G.S. became significantly large with  
respect to calculated plastic zone sizes. Experiments were conducted to correlate  
microstructure and mechanical properties for Ti-6-2--4-4.

REPORT NO: AFML-TR-75-101 AD B 006 928 L  
ACCESS NO: 203,886 July 1975  
TITLE: CRACK ARREST IN TITANIUM  
AUTHOR(S): S. Burns  
CONTRACT NO: F33615-74-C-5064  
CONTRACTOR: University of Rochester  
PROJECT MONITOR: R. Donat (AFML/LLN)  
PROJECT NO: 7351  
TASK NO: 735106  
DIST. STATEMENT: U.S. Govt. Agencies Only



AFML/LL

**ABSTRACT:** The propagation of cracks in commercial grade Ti-6Al-4V was investigated by detailed measurements of crack lengths versus time. Critical stress intensity factors during crack propagation were calculated from a fully dynamic mechanics analysis of propagating cracks. It was found that critical stress intensity factors increase with increasing crack velocity. Mechanical and metallurgical characterization of two Ti-6Al-4V alloys were investigated to identify possible sources of fracture toughness.

REPORT NO: AFML-TR-75-105  
ACCESS NO: 204,094 June 1975  
TITLE: WATER DROP/BOW SHOCK INTERACTIONS  
AUTHOR(S): Dr. J. Barber, Dr. E. Grood, H. Taylor, et al.  
CONTRACT NO: F33615-73-C-5027  
CONTRACTOR: University of Dayton  
PROJECT MONITOR: Dr. A. Hopkins (AFML/LLN)  
PROJECT NO: 7351  
TASK NO: 735106  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: The interaction of water drops of diameters in the range of 20 to 200  $\mu$ m with reentry vehicle bow shocks was investigated with a microscope/Q-spoiled laser camera system. An analytical study of the droplet/bow shock interaction was undertaken. Calculations showed that droplets above about 20  $\mu$ m in diameter should remain intact and impact the projectile nose tip in the stagnation region. In the stagnation region, droplets of this size should experience little deviation from a straight trajectory. These predictions were confirmed experimentally using the techniques described in this report.

REPORT NO: AFML-TR-75-119 AD A 020 021  
ACCESS NO: 204,100 September 1975  
TITLE: RESEARCH TOWARD HIGH STRENGTH HIGH TOUGHNESS STEELS  
AUTHOR(S): Staff Report  
CONTRACT NO: F33615-73-C-5100  
CONTRACTOR: University of California at Berkeley  
PROJECT MONITOR: W. Griffith (AFML/LLS)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: Several different ways of microstructural control were attempted in maraging type steels in order to achieve a combination of high strength and high toughness. In Section I, the composition, processing, and mechanical properties of Fe-Ni-Ti alloys are described. In Section II, the well-known toughening mechanism, i.e., grain refinement, retained austenite, and the TRIP (transformation induced plasticity) mechanism are incorporated to a 250 grade maraging steel. In Section III we report initial success with an alternate toughening technique: the introduction of a dense mobile dislocation density through rapid phase transformation of a partially maraged structure.

REPORT NO: AFML-TR-75-121 AD A 018 670  
ACCESS NO: 204,057 October 1975  
TITLE: TWO DIMENSIONAL STRESS INTENSITY FACTOR SOLUTIONS FOR RADIALY CRACKED RINGS  
AUTHOR(S): Capt. A. Grandt  
CONTRACT NO: N/A  
CONTRACTOR: Internal  
PROJECT MONITOR: Capt. A. Grandt (AFML/LLN)  
DIST. STATEMENT: Approved for public release; distribution unlimited.

AFML/LL

ABSTRACT: A weight function technique is used to obtain mode I stress intensity factor solutions for radially cracked rings loaded with arbitrary crack face pressure. When the crack face pressure is defined as the hoop stress occurring in an unflawed member subjected to complex loading, stress intensity factor calibrations may be obtained by the linear superposition method. This procedure is demonstrated with calculations for rings loaded in compression, for cylinders under internal and external pressure, and for centrifugal stresses induced by rotating the rings. Solutions obtained in this manner agree well with previous results found by other methods. It is suggested that the solution and techniques described here may have further application to other practical problems.

REPORT NO: AFML-TR-75-140 AD A 018 059  
ACCESS NO: 204,007 October 1975  
TITLE: INFLUENCE OF IRON AND SILICON CONTENT ON THE  
TENSILE PROPERTIES OF 7X75 AND ZR-MOLDED 7X75  
ALUMINUM PLATE

AUTHOR(S): Lt. P. Blau  
CONTRACT NO: N/A  
CONTRACTOR: internal  
PROJECT MONITOR: Lt. P. Blau (AFML/LLS)  
ABSTRACT: This report studied how tensile strength and ductility of 7475-type aluminum plates were affected by Fe and Si content, minor Zr substitutions for Cr, and thermomechanical processing (TMP) versus T651 tempers. In all, twenty combinations of composition and temper were examined. Smooth tensile specimens with 1/4 and 1/2 inch diameters were used. As Fe and Si content decreased, elongation and reduction of area increased in all but the T651 Zr-containing alloys. Purity had little effect on ultimate tensile and yield strength. The Zr-containing alloys were generally stronger than the Cr-containing alloys and had comparable ductility. Compared to the T651 temper, TMP had lower strength and higher ductility. TMP also increased the alloys' sensitivity to the Fe and Si content.

REPORT NO: AFML-TR-75-143 AD A 020 083  
ACCESS NO: 204,114 August 1975  
TITLE: MICROSTRUCTURE MECHANICAL PROPERTY RELATIONSHIP  
IN SUPERALLOYS

AUTHOR(S): M. Menon  
CONTRACT NO: F33615-75-C-5207  
CONTRACTOR: Wright State University  
PROJECT MONITOR: W. Reimann (AFML/LLN)  
PROJECT NO: 7351  
TASK NO: 735106 A8  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: The primary objectives of this program were to investigate the conditions leading to the abnormal grain growth behavior in Rene 95 extrusions, and to study the microstructure of AF115 and the effect of hold time conditions on the low-cycle fatigue behavior of necklace Rene 95. A three phase experimental program was designed to accomplish this goal. In the study of grain growth behavior it was found that the material when extruded below the gamma-prime solvus temperature did not undergo secondary recrystallization in a subsequent anneal with a fast heating rate at a higher temperature. However, when a slow heating rate was employed, the extrusions showed significant indications of secondary recrystallization.

AFML/LL

REPORT NO: AFML-TR-75-144  
ACCESS NO: 204,006  
TITLE: EXPLORATORY DEVELOPMENT TO STUDY THE  
LONG-TERM EFFECTS OF RESORBABLE CERAMICS IN PRIMATES  
AUTHOR(S): G. Graves, F. Noyes  
CONTRACT NO: F33615-72-C-1835  
CONTRACTOR: University of Dayton Research Institute  
PROJECT MONITOR: Dr. R. Ruh (AFML/LLM)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: The objective of the program was to study the suitability and long-term effect of resorbable ceramic implants as bone gap bridges in Rhesus monkeys. The long-range goal of work of this type is to demonstrate the feasibility of long bone repair in humans using resorbable ceramic implants. The ceramics used as implants were porous calcium aluminates with phosphorous pentoxide additions. Medical examination of the soft tissue surrounding the implants showed no sign of infection or toxic reaction. Medical examination of the major organ showed no visible signs of infection or other untoward reaction. Examination of the implants using a scanning electron microscope revealed that the composition and resulting pore structure did not encourage manualized bone ingrowth. Short-term implant studies have since shown that an increased amount of  $P_2O_5$  (20%) and a pore size of 60 - 80  $\mu m$  provides the optimum amount of resorption and bone ingrowth.

September 1975

REPORT NO: AFML-TR-75-168  
ACCESS NO: 204,099  
TITLE: MECHANICAL PROPERTIES OF STRUCTURAL GRADES  
OF BERYLLIUM AT HIGH STRAIN RATES  
AUTHOR(S): T. Nicholas  
CONTRACT NO: N/A  
CONTRACTOR: internal  
PROJECT MONITOR: T. Nicholas (AFML/LLN)  
PROJECT NO: 7351  
TASK NO: 735106  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: An experimental technique is described for obtaining high rate tensile stress strain data on materials with limited ductility. A modified split Hopkinson bar apparatus is used to obtain data on three advanced structural grades of beryllium at strain rates up to 500  $sec^{-1}$ . The data indicate that there is no significant loss in ductility with increasing strain rate in any of the three grades of beryllium. Flow stress is shown to increase linearly with strain rate up to strain rates of 1 - 10  $sec^{-1}$  and then more abruptly at higher rates.

AD A 020 076  
October 1975

REPORT NO: AFML-TR-75-171  
ACCESS NO: 204,135  
TITLE: A TEST METHOD FOR EVALUATION OF METAL POWDERS  
AUTHOR(S): N. Birla, V. DePierre  
CONTRACT NO: F33615-73-C-5097  
CONTRACTOR: University of Cincinnati  
PROJECT MONITOR: A. Adair, V. DePierre (AFML/LLM)  
PROJECT NO: 7351  
TASK NO: 73510815  
DIST. STATEMENT: Approved for public release; distribution unlimited.

AD A 020 322  
October 1975



**ABSTRACT:** A speedy and economical test method for determining the potential of metal powders to achieve desired mechanical properties after consolidation is described. It consists of encapsulating metal powders in an evacuated metal tube and reducing the outside diameter of the powder-filled tube by swaging to produce a fully consolidated powder bar which provides material for tensile testing. The tensile test results measure the potential of the metal powders. Application of the method to an evaluation of spherical (REP) and angular (H/DH) titanium alloy (Ti-6Al-2Sn-4Zr-6Mo) metal powders demonstrates the procedure can also be utilized to determine processing properties of metal powders. Results show both spherical and angular powders upon complete consolidation furnish tensile properties equivalent to conventional wrought Ti-6246 material. Results also indicate that the hydride powders (1.9% hydrogen) are less apt to be contaminated during processing. The test method is recommended as an excellent tool for determining the potential of metal powders to achieve mechanical properties and for establishing optimum processing parameters for consolidation of metal powders.

ELECTROMAGNETIC MATERIALS DIVISION (AFML/LP)

REPORT NO: AFML-TR-74-223 AD B 001 796 L  
 ACCESS NO: 203,345 October 1974  
 TITLE: EXPLORATORY DEVELOPMENT ON THE FEASIBILITY  
 AND RECOMMENDATION FOR NDI OF IR WINDOWS  
 AUTHOR(S): D. Smith, A. Oaks  
 CONTRACT NO: F33615-74-C-5125  
 CONTRACTOR: General Electric Co.  
 PROJECT MONITOR: J. Fenter (AFML/LPO)  
 DIST. STATEMENT: U.S. Govt. Agencies Only  
 ABSTRACT: A survey and evaluation have been conducted of the state-of-the-art in nondestructive inspection (NDI) techniques for potential application for monitoring real-time in situ performance of a solid high energy laser window of an operational system. As a basis for evaluation, the AFML Airborne Laser Laboratory (ALL) Low Power External Window (LPEW) was chosen for the application. Of the 25 individual techniques evaluated, 6 were found to have promise and one was recommended for consideration when and if a design change is contemplated for the present ALL Automatic Pointing and Tracking (APT) system to accommodate the access requirement.

REPORT NO: AFML-TR-74-240  
 ACCESS NO: 69,009 December 1974  
 TITLE: DEVELOPMENT OF CHALCOPYRITE CRYSTALS FOR  
 NONLINEAR OPTICAL APPLICATIONS  
 AUTHOR(S): R. Begley, et al.  
 CONTRACT NO: F33615-72-C-2011  
 CONTRACTOR: Stanford University  
 PROJECT MONITOR: V. Donlan (AFML/LPJ)  
 DIST. STATEMENT: Approved for public release; distribution unlimited.  
 ABSTRACT: This final report summarizes recent progress in the growth of three chalcopyrite crystals, CdGeAs<sub>2</sub>, AgGaSe<sub>2</sub> and AgGaS<sub>2</sub>. Recent applications of these crystals to the generation of tunable infrared radiation has been more actively pursued as a result of a number of important requirements for tunable sources. The bulk of this final report treats in detail the theory of nonlinear interactions in solids. The treatment includes a discussion of third and fourth harmonic generation. Recent work in AgGaSe<sub>2</sub> for infrared generation by mixing is presented in Appendix III as a reprint. Also included in Appendix IV is a preprint of a paper describing a new model for the calculation of second order nonlinear susceptibilities. The Bond Orbital Model is a physically descriptive model which should prove useful for estimating nonlinear properties of new semiconducting crystal compounds.

REPORT NO: AFML-TR-74-268 AD A 007 852  
 ACCESS NO: 203,442 November 1974  
 TITLE: PYROELECTRIC FILM/LIQUID CRYSTAL DETECTOR  
 FOR 10.6  $\mu$ m REGION  
 AUTHOR(S): J. Margerum, M. Little, and P. Braatz  
 CONTRACT NO: F33615-73-C-5129  
 CONTRACTOR: Hughes Research Laboratories  
 PROJECT MONITOR: R. Rondeau (AFML/LPJ)  
 DIST. STATEMENT: Approved for public release; distribution unlimited.

**ABSTRACT:** The development of a new type of large area infrared detector cell with visible light readout is studied in which a liquid crystal layer is electro-optically activated by a pyroelectric film. These studies include the evaluation of pyroelectric films and their poling techniques, the evaluation of liquid crystals for use with pyroelectric currents, analysis of thermal time constants in various cell layers, evaluation of signals obtained with test cells, and the development of prototype detectors. Polyvinylidene fluoride (PVF<sub>2</sub>) is selected as the best large area pyroelectric material available and responsivities as high as 5.5  $\mu$  A/W are obtained with freely suspended poled films.

REPORT NO: AFML-TR-74-274  
 ACCESS NO: 201,818 February 1975  
 TITLE: ROOM TEMPERATURE INJECTION LUMINESCENCE  
 IN II-VI SEMICONDUCTORS  
 AUTHOR(S): N. Low, L. Bradfield  
 CONTRACT NO: F33615-72-C-1466  
 CONTRACTOR: Bowmar Research and Development Division, Canada  
 PROJECT MONITOR: Dr. P. Heminger (AFML/LPO)  
 PROJECT NO: 7367  
 TASK NO: 736703

DIST. STATEMENT: Approved for public release; distribution unlimited.  
 ABSTRACT: In a continuation of previous investigations of injection luminescent device structures based on single crystal ZnS, several theoretical models are discussed which may account for the blue electroluminescence emission from nominally undoped or compensated ZnS diodes. It was postulated that hot carrier injection from In-ZnS Schottky barriers might be a likely process as needle-like voids filled with indium were observed in the ZnS crystal. An alternative objective for the investigations has involved experimental work on polycrystalline II-VI compounds, subsequently extended to polycrystalline III-V compound materials, and the evaluation of the potential of these materials in light-emitting device applications. Other experimental studies included such studies as comprehensive evaluation program on the morphological features of the ZnSe powders and the microstructure of the hot-pressed II-VI and III-V compound powdered compact.

REPORT NO: AFML-TR-74-277 AD A 011 779  
 ACCESS NO: 203,569 January 1975  
 TITLE: MAGNETIC RELAXATION EFFECTS IN PrCo<sub>5</sub>  
 AND Sm<sub>x</sub>Nd<sub>1-x</sub>Co<sub>5</sub> INDUCED BY HYDROGEN AND DEUTERIUM  
 AUTHOR(S): I. Maartense  
 CONTRACT NO: F33615-73-C-5060  
 CONTRACTOR: University of Manitoba  
 PROJECT MONITOR: D. Evans (AFML/LPJ)  
 DIST. STATEMENT: Approved for public release; distribution unlimited.  
 ABSTRACT: Measurements of the ac susceptibility of PrCo<sub>5</sub> powder parallel to its c-axis show the existence of two relaxation processes which are present in samples exposed to hydrogen or deuterium but not in degassed samples. The two relaxations have time constants of 10 sec. at 165°K and at 200°K and are described by effective activation energies of 0.37 eV and 0.51 eV, respectively. Sm<sub>x</sub>Nd<sub>1-x</sub>Co<sub>5</sub> crystals treated with hydrogen show a magnetic relaxation equivalent to the higher energy process in PrCo<sub>5</sub>; between -20°C and 50°C, a strong Barkhausen effect dominates the magnetic behavior.



AFML/LP

REPORT NO: AFML-TR-74-281 AD A 008 782  
 ACCESS NO: 203,502 February 1975  
 TITLE: PERFECTION OF CaLaSOAP:Nd LASER MATERIAL  
 AUTHOR(S): R. Hopkins, et al.  
 CONTRACT NO: F33615-74-C-5023  
 CONTRACTOR: Westinghouse Electric Corp.  
 PROJECT MONITOR: V. Donlan (AFML/LPJ)  
 DIST. STATEMENT: Approved for public release; distribution unlimited.  
 ABSTRACT: Calcium lanthanum silicate oxyapatite (CaLaSOAP) is an intermediate gain laser material developed for high energy storage and high average power Q-switching applications. The objective of this program was to increase the bulk and surface laser damage resistance of CaLaSOAP crystals and the yield of laser quality boules so that the full potential of the material could be realized in Q-switched laser ranger systems. Crack-free crystals up to 0.7 in. diameter were grown and fabricated into optically homogeneous 0.375 diameter laser rods free from inclusions detectable by laser light scattering. The key to this result was the reduction in thermal gradient in the growth system, use of O<sub>2</sub>/N<sub>2</sub> furnace atmospheres, and the automatic control of crystal diameter to within  $\pm 1$  to 2%. Boule yield was nearly tripled to 77% compared to precontract results.

REPORT NO: AFML-TR-75-10 AD A 018 128  
 ACCESS NO: 204,035 July 1975  
 TITLE: EXPERIMENTAL HYSTERETIC LOSS FOR A SERIES OF SUPERCONDUCTING FILAMENTARY NbTi WIRES AND A FIELD DEPENDENT CRITICAL STATE MODEL  
 AUTHOR(S): M. Ohmer, J. Wollan, L. Lawson  
 CONTRACT NO: N/A  
 CONTRACTOR: internal  
 PROJECT MONITOR: Dr. M. Ohmer (AFML/LPE)  
 DIST. STATEMENT: Approved for public release; distribution unlimited.  
 ABSTRACT: This report summarizes the Air Force superconducting wire applications, the goals of future superconducting materials development, the state-of-the-art theories of ac loss in superconductors, and the results of hysteretic loss measurements on a series of niobium titanium multifilamentary wires. Expressions were developed for magnetization and hysteretic loss for half cycle and full cycle for rod geometries for a critical state model with critical current inversely proportional to field. The loss expressions of various models are compared to experimental loss. Universal loss curves constructed from experimental loss curves by appropriate normalization are obtained and used to predict loss accurately. The temperature dependence of the critical current for niobium titanium, niobium (sub 3)-tin, and niobium carbonitride was obtained from magnetization curves through the critical state model.

REPORT NO: AFML-TR-75-15 AD B 004 218 L  
 ACCESS NO: 203,566 February 1975  
 TITLE: SOME EFFECTS OF ENVIRONMENTAL FACTORS ON THE PERFORMANCE OF COATINGS FOR HIGH POWER IN LASERS  
 AUTHOR(S): G. Johnston, D. Walsh  
 CONTRACT NO: F33615-74-C-5001  
 CONTRACTOR: University of Dayton Research Institute  
 PROJECT MONITOR: C. Strecker (AFML/LPO)  
 DIST. STATEMENT: U.S. Govt. Agencies Only

AFML/LP

**ABSTRACT:** A series of tests has been performed to evaluate the effect of environmental factors on the optical performance of antireflective coated ZnSe. The primary objective of the tests was to determine the effect of cloth abrasion, sand erosion, and temperature-humidity cycling on the reflectance, scattering, surface topography, and absorption coefficient of the coated specimens. A secondary objective was to determine the effects of environmental factors on the resistance to damage by medium power (1 KW) CO<sub>2</sub> laser irradiation. After post-test characterization of the separate effects, selected combinations of the tests were evaluated. In general the sensitivity of the 10.6  $\mu$ m optical performance of the coatings to environmental factors was less than had been anticipated. Measurable increases in absorption coefficient and specular reflection required grossly visible mechanical damage.

REPORT NO: AFML-TR-75-18  
ACCESS NO: 203,173  
TITLE: PROTECTIVE-ANTIREFLECTIVE THIN FILMS FOR  
POLYCRYSTALLINE ZINC SELENIDE AND ALKALI  
HALIDE LASER WINDOWS

February 1975

AUTHOR(S): M. Braunstein, J. Rudisill  
CONTRACT NO: F33615-73-C-5044  
CONTRACTOR: Hughes Research Laboratories  
PROJECT MONITOR: Dr. M. Ohmer (AFML/LPO)  
DIST. STATEMENT: U. S. Govt. Agencies Only

**ABSTRACT:** The development of surface finishing and coating technology at 10.6  $\mu$ m for polycrystalline zinc selenide laser windows is presented. Optical evaluation of the coated windows shows that the 10.6  $\mu$ m absorption, reflection, and scattering can be held to less than 0.1% per surface. Surface finishing procedures, theoretical coating designs, and experimental results for BaF<sub>2</sub>/ZnS, ThF<sub>4</sub>/ZnS, and ThF<sub>4</sub>/ZnSe antireflection coating designs are presented. Efforts devoted to ZnSe demonstrate the scalability of the processes used for polishing and coating of small discs to fabrication of large diameter laser windows. Surface finishing procedures, theoretical coating designs, and experimental results for ZnSe/ThF<sub>4</sub> and As<sub>2</sub>S<sub>3</sub>/ThF<sub>4</sub> antireflection coatings for HRL RAP grown KCl are presented.

REPORT NO: AFML-TR-75-21  
ACCESS NO: 203,497  
TITLE: EXPLORATORY DEVELOPMENT OF TRANSPARENT  
CONDUCTOR MATERIALS

AD A 008 783  
March 1975

AUTHOR(S): G. Haacke  
CONTRACT NO: F33615-74-C-5021  
CONTRACTOR: American Cyanamid Co.  
PROJECT MONITOR: R. Van Vliet (AFML/LPO)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
**ABSTRACT:** The development of electrically conductive cadmium stannate coatings with high visible transparency and high infrared reflectivity has been pursued. Efforts concentrated on the investigation of different deposition technologies, film doping, coating of various substrate materials, and film testing.

AFML/LP

REPORT NO: AFML-TR-75-23 AD A 014 360  
ACCESS NO: 203,798 February 1975  
TITLE: AC LOSS AS A FUNCTION OF CURRENT AND EXTERNAL  
MAGNETIC FIELD IN COMMERCIAL NbTi SUPERCONDUCTORS  
AUTHOR(S): D. Ho, M. Robinson, V. Srivastava, R. Stevenson  
CONTRACT NO: F33615-73-C-5163  
CONTRACTOR: Canada Superconductor and Cryogenics Co., Ltd.  
PROJECT MONITOR: Dr. M. Ohmer (AFML/LPO)  
PROJECT NO: 62102F  
TASK NO: 73710324  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: Alternating current loss as a function of current and external  
magnetic field in commercial NbTi superconductors has been measured with an  
electronic wattmeter. The loss varies as the current cubed, and the increase of  
loss with the external magnetic field could be related to the decrease of the d.c.  
short sample current with field.

REPORT NO: AFML-TR-75-27 AD A 014 362  
ACCESS NO: 203,805 April 1975  
TITLE: CHEMICAL VAPOR DEPOSITON OF MULTISPECTRAL DOMES  
AUTHOR(S): B. di Benedetto, J. Pappis  
CONTRACT NO: F33615-73-C-1073  
CONTRACTOR: Raytheon Co.  
PROJECT MONITOR: D. Fischer (AFML/LPO)  
PROJECT NO: 7371  
TASK NO: 737101  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: The significance of this development program to the Air Force  
is the demonstrated capability of fabricating chemical vapor deposited zinc sul-  
fide windows and hemispherical domes. A zinc sulfide plate, 10 X 10 X 5/8 in.,  
and a 9-inch hemispherical dome were fabricated and optically polished to speci-  
fication. As a result of this work the optical and structural properties of zinc  
sulfide were significantly improved. It was also demonstrated that it is possible  
using the CVD process to deposit multiple domes per run. Significant progress was  
also made in the development of zinc sulfo-selenide solid solutions. Improvements  
were realized in the optical and structural properties of these deposits.

REPORT NO: AFML-TR-75-28  
ACCESS NO: 201,819 April 1975  
TITLE: THERMAL, ELECTRICAL AND PHYSICAL PROPERTY  
MEASUREMENTS OF LASER WINDOW MATERIALS  
AUTHOR(S): J. Wurst, T. Graham  
CONTRACT NO: F33615-72-C-1257  
CONTRACTOR: University of Dayton Research Institute  
PROJECT MONITOR: C. Strecker (AFML/LPO)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: Various II-VI and alkali halide compounds were subjected to a  
comprehensive evaluation to determine their relative effectiveness in a CO<sub>2</sub> laser  
window application. Primary emphasis was directed towards mechanical properties  
and more than 600 flexural test specimens were evaluated in the course of this 20  
month effort. Evaluation of the alkali halides KCl, KBr, NaCl, and their alloys  
was initiated midway through the program. KCl alloyed with KBr, RbCl or Eu<sup>+2</sup> and  
hot forged to produce a fine-grained microstructure was the most promising of the  
alkali halides. Bests results were obtained with alloys grown as single crystals  
by Harshaw and subsequently hot forged by Honeywell Corporation.



AFML/LP

REPORT NO: AFML-TR-75-34 AD A 019 452  
ACCESS NO: 204,093 October 1975  
TITLE: DEVELOPMENT OF LIQUID CRYSTAL SYSTEMS FOR  
AIR FORCE DISPLAY APPLICATIONS  
AUTHOR(S): R. Rondeau, L. Knaak, H. Rosenberg, R. Steppel  
CONTRACT NO: N/A  
CONTRACTOR: internal  
PROJECT MONITOR: R. Rondeau (AFML/LPJ)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: A series of 4 (4')--alkoxyformyloxy-4' (4)-alkylazoxybenzenes  
were prepared. The transition temperatures have been determined and the applica-  
bility of the nuclear magnetic resonance spectral shift reagent Eu (fod)<sub>3</sub> to  
determine the mole percent of structural isomeric mixtures is demonstrated. A  
survey has been made of reported nematic-isotropic transition temperatures of  
nematic liquid crystals having a particular structure.

REPORT NO: AFML-TR-75-49 AD A 014 809  
ACCESS NO: 203,821 May 1975  
TITLE: DEVELOPMENT OF GALLIUM ARSENIDE FOR INFRARED WINDOWS  
AUTHOR(S): H. Hafner, G. Cronin  
CONTRACT NO: F33615-74-C-1066  
CONTRACTOR: Texas Instruments Incorporated  
PROJECT MONITOR: D. Fischer (AFML/LPO)  
PROJECT NO: 7371  
TASK NO: 737101  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: This report describes methods for preparing high quality  
infrared transmitting gallium arsenide. The work is broadly divided into categories  
describing doping studies, vertical pulling techniques, liquid encapsulation, growth  
methods, horizontal Bridgman and gradient freeze techniques, boat materials, and  
measurement results. In addition to infrared transmission curves, data are also  
presented which describe other physical parameters such as Knoop hardness and  
refractive index.

REPORT NO: AFML-TR-75-66 AD A 013 878  
ACCESS NO: 203,787 May 1975  
TITLE: GROWTH OF DOPED AND UNDOPE SINGLE CRYSTAL  
LASER MATERIALS IN THE SYSTEM  $(\text{MF}_2)_x \cdot (\text{YF}_3)_{1-x}$   
AUTHOR(S): Dr. J. Balascio  
CONTRACT NO: F33615-73-C-5058  
CONTRACTOR: Isonet Corporation  
PROJECT MONITOR: D. Fischer (AFML/LPO)  
PROJECT NO: 7371  
TASK NO: 737101  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: Laser host materials were grown in the  $\text{CaF}_2\text{-YF}_3$  and  $\text{BaF}_2\text{-YF}_3$   
binaries. Two compositions in the former binary were found to be capable of pro-  
ducing single crystals:  $9\text{CaF}_2\text{-YF}_3$  and  $\text{CaF}_2 \cdot 2.6\text{YF}_3$ . The former possessed a fluorite  
structure and the latter was indexed on a hexagonal unit cell. Trivalent and  
divalent rare earth-doped single crystals of these compositions were successfully  
grown. The necessary phase equilibria is presented and discussed.

AFML/LP

REPORT NO: AFML-TR-75-68  
ACCESS NO: 203,682  
TITLE: CHEMICAL VAPOR DEPOSITION OF CADMIUM TELLURIDE  
CONTRACT NO: F33615-73-C-5167  
CONTRACTOR: Raytheon Research Division  
PROJECT MONITOR: Dr. P. Hemenger (AFML/LPO)  
PROJECT NO: 2421  
TASK NO: 0002  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: Chemical vapor deposition techniques have been used to successfully deposit polycrystalline CdTe. The following two reactions were used to obtain theoretically dense material:  $\text{Cd(v)} + \text{Te(v)} \rightarrow \text{CdTe(s)}$ ;  $\text{Cd(v)} + \text{H}_2\text{Te(v)} \rightarrow \text{CdTe(s)} + \text{H}_2\text{(v)}$ . Typical deposition temperatures ranged between 600° and 700°C, pressures varied from 10 to 40 torr, and the Cd(v)/Te(v) molar input ratios were between 1.0 and 1.5. The major problem encountered with the CdTe was the formation of physical voids in the material during the deposition process. Progress was made to limit the formation of these voids in the latter stages of the contract. The in-line transmittance of the as-deposited CdTe approached the theoretical limit of 66% at 10.6  $\mu\text{m}$ . Typical material was p-type with resistivities ranging up to  $10^7$  ohm-cm.

March 1975

REPORT NO: AFML-TR-75-73  
ACCESS NO: 203,898  
TITLE: FLUORIDE WINDOW MATERIALS FOR USE AS LASER WINDOWS IN THE 2 TO 6  $\mu\text{m}$  SPECTRAL REGION  
AUTHOR(S): H. Winston, R. Pastor, R. Turk, et al.  
CONTRACT NO: F33615-73-C-5075  
CONTRACTOR: Hughes Research Labs  
PROJECT MONITOR: J. Fenter (AFML/LPO)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: Exploratory development of alkaline earth fluorides for application as high-power laser windows in the 2 to 6  $\mu\text{m}$  spectral region was conducted. Designs for wideband antireflection coatings to accommodate the multi-line outputs of chemical lasers are presented, along with the results of preliminary experiments on depositing appropriate layers to meet design requirements. Infrared and ultraviolet spectra of window blanks show mainly the intrinsic absorption cutoffs of the materials; some impurity absorption is visible in long-path IR spectra. Changes in attenuated total reflections (ATR) spectra with surface treatment can be observed. RAP crystal growth and subsequent press forging can be extended to provide  $\text{CaF}_2$  and  $\text{SrF}_2$  window blanks of any required size.

AD B 007 238 L  
May 1975

REPORT NO: AFML-TR-75-79  
ACCESS NO: 204,097  
TITLE: PROCEEDINGS OF THE FOURTH ANNUAL CONFERENCE ON INFRARED LASER WINDOW  
AUTHOR(S): C.R. Andrews, C. Strecker  
CONTRACT NO: F33615-75-C-5011  
CONTRACTOR: University of Dayton  
PROJECT MONITOR: C. Strecker (AFML/LPO)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: The fourth Conference on Infrared Laser Window Materials was sponsored by the Advanced Research Projects Agency and held in Tucson, Arizona on November 18, 19, and 20, 1974. In the three years since the initiation of laser window programs, there has been a continual evolution and advancement in the applied and exploratory research and development of laser window materials. Within the past year, laser window design and hardware productions have been undertaken and completed. Numerous achievements in fabrication and characterization of laser window materials were treated.

AD B 008 167 L  
September 1975

AFML/LP

REPORT NO: AFML-TR-75-87 AD A 013 069  
ACCESS NO: 203,699 April 1975  
TITLE: MATERIALS AND TECHNOLOGY FOR NEW INFORMATION DISPLAYS  
AUTHOR(S): P. Hemenger  
CONTRACT NO: N/A  
CONTRACTOR: internal  
PROJECT MONITOR: Dr. P. Hemenger (AFML/LPO)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: The current status of electroluminescent materials and devices is reviewed. The limitations of the presently important materials GaP (gallium-phosphide) and GaAsP (gallium-arsenide-phosphide) are discussed, followed by a survey of candidate materials for future display systems. In particular, the potential of the II-VI semiconductors is presented along with some recent experimental results.

REPORT NO: AFML-TR-75-89 AD A 011 748  
ACCESS NO: 203,626 April 1975  
TITLE: ZINC ION IMPLANTATION OF SULFUR-DOPED GALLIUM PHOSPHIDE  
AUTHOR(S): P. Hemenger, B. Dobbs  
CONTRACT NO: N/A  
CONTRACTOR: internal  
PROJECT MONITOR: Dr. P. Hemenger (AFML/LPO)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: Sulfur-doped GaP has been implanted with 250-keV Zn ions to a total dose of  $10^{16} \text{ cm}^{-2}$  and then annealed at  $900^{\circ}\text{C}$ . Hall data obtained with the van der Pauw configuration indicate type conversion in a surface layer that has a thickness estimated from diffusion data and electrical transport properties, on the order of  $10 \mu\text{m}$ . For large implant doses followed by annealing, the diffusion of Zn in GaP plays a significant role in the final location of the implanted ions.

REPORT NO: AFML-TR-75-91  
ACCESS NO: 204,098 August 1975  
TITLE: CHEMICAL VAPOR DEPOSITION OF CHALCOGENIDE SEMICONDUCTORS  
AUTHOR(S): H. K. Bowen, J. Vander Sande  
CONTRACT NO: F33615-73-C-5166  
CONTRACTOR: M.I.T.  
PROJECT MONITOR: Dr. P. Hemenger (AFML/LPO)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: Polycrystalline CdTe was prepared by vapor deposition rates of 0.1-0.01 mm/hr at temperatures between  $725-785^{\circ}\text{C}$ . Columnar grains and micron size pores were found in all samples. Electrical property measurements and x-ray texture studies were made. Transmission electron microscopy elucidated the nature of precipitates and voids ( $50-100 \text{ \AA}$ ) in the as grown material and material from other sources. Scattering theory calculations indicate orders of magnitude agreement with the observed absorption coefficients at  $10.6 \mu\text{m}$ . A new absorption measuring technique was developed capable of determining accurately on small samples. The thermal shift in the fundamental absorption edge due to infrared absorption ( $10.6 \mu\text{m}$ ) was used. Both the theory and measurement system were defined.



AFML/LP

REPORT NO: AFML-TR-75-104  
ACCESS NO: 203,994  
TITLE: HALIDE MATERIAL PROCESSING FOR HIGH-POWER,  
INFRARED LASER WINDOWS  
AUTHOR(S): W. Harrison  
CONTRACT NO: F33615-72-C-2019  
CONTRACTOR: Honeywell, Inc.  
PROJECT MONITOR: J. Fenter (AFML/LPO)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: This report describes the complete process which was developed for strengthening and characterizing four different single component alkali halides as well as many alloyed and doped halide materials. Hot forged, recrystallized alloyed and doped material, in general, had about the same optical properties as the single crystal material; however, residual stress in the recrystallized material was relatively high and strongly dependent upon the crystal orientation of the forged crystal. It was shown that large recrystallized halide laser windows can be fabricated which have greater than 4000 psi yield strengths with an optical absorption coefficient of  $0.6 \times 10^{-3}/\text{cm}$ , optical uniformity of  $\lambda/80$  at  $10.6 \mu\text{m}$ , and bulk optical scatter of less than  $1 \times 10^{-5}/\text{cm}$ .  
September 1975

REPORT NO: AFML-TR-75-142  
ACCESS NO: 204,037  
TITLE: HARDENED CVD ZINC SELENIDE FOR FLIR WINDOWS  
AUTHOR(S): R. Donadio, A. Swanson, J. Pappis  
CONTRACT NO: F33615-74-C-5145  
CONTRACTOR: Raytheon Co.  
PROJECT MONITOR: Dr. G. Kuhl, D. Fischer (AFML/LPO)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: The significance of this exploratory development program to the Air Force is the demonstration that the CVD process can be used to increase the hardness of optical materials such as zinc selenide and sulfide by the use of dopants such as aluminum and silicon. Increases in Knoop hardness of 50 to 100 percent were realized, although some degradation in optical properties was noted, particularly at visible wavelengths. It was also demonstrated that the CVD process can be used to deposit a thin adhering layer of zinc sulfide or hardened sulfide or selenide to a polished zinc selenide substrate. Finally, it was shown that an elemental CVD process is a feasible method of producing lower cost ZnSe for Flir window applications. Transmittances close to the theoretical limit were achieved and the goal of achieving a cost of \$5,000 for 10X10X10.62 in. unpolished plate can be met in production.  
AD A 018 682  
September 1975

MANUFACTURING TECHNOLOGY DIVISION (AFML/LT)

REPORT NO: AFML-TR-73-198 AD 919 288 L  
ACCESS NO: 67,738 July 1973  
TITLE: PLANETARY BALL SWAGING OF WELDED TITANIUM ALLOY TUBING  
AUTHOR(S): R. Huber, et al.  
CONTRACT NO: F33615-70-C-1279  
CONTRACTOR: Nuclear Metals  
PROJECT MONITOR: T. Felker (AFML/LTM)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: The objective of this program was to provide economic and versatile methods for the production of titanium alloy tubing for advanced aircraft components such as hydraulic systems. Optimum sequences were established for processing welded tubing of diverse sizes and compositions with the planetary ball swager so that the final welded and worked tubing was at least equivalent in properties and attributes to seamless tubing for aircraft application.

REPORT NO: AFML-TR-74-200  
ACCESS NO: 203,995 May 1975  
TITLE: COMPLEMENTARY BIPOLAR TRANSISTOR STRUCTURES  
AUTHOR(S): F. Poblentz, F. Malone, W. Giolma  
CONTRACT NO: F33615-71-C-1944  
CONTRACTOR: Texas Instruments Incorporated  
PROJECT MONITOR: E. Miller (AFML/LTE)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: The objective of this contract was to establish advanced process procedures for manufacturing high-yield, low-cost, dielectrically isolated n-p-n and p-n-p transistors and other electronic circuitry on a single-monolithic semiconductor chip. The development of the two processes (high and low gain) was established and confirmed by the test results on the SN39561 complementary bipolar transistor structures. The special test structures of the X-727 were also used to confirm the established process and then to maintain control over the process. The SN39561 met and, in some instances, exceeded the specifications established for this program. Phase II demonstrated that acceptable production processes had been established in Phase I by successfully manufacturing a dual voltage regulator and a low power operational amplifier.

REPORT NO: AFML-TR-74-202 AD B 001 110 L  
ACCESS NO: 203,286 October 1974  
TITLE: PHASE SHIFTER MANUFACTURING METHODS  
AUTHOR(S): R. May, D. Lewis  
CONTRACT NO: F33615-73-C-5160  
CONTRACTOR: Hughes Aircraft Co.  
PROJECT MONITOR: H. Trinkle (AFML/LTE)  
DIST. STATEMENT: U.S. Govt. Agencies Only

AFML/LT

**ABSTRACT:** It is concluded from the results of the Phase Shifter Manufacturing Methods Program that low-cost production of the Hughes PIN diode phasor is practicable. The program involved six steps; (1) configuration of a phasor suitable for large quantity production; (2) analysis of available methods for fabrication of each phasor component and selection of the methods best suited for large quantity production; (3) experimental investigation of practical assembly techniques; (4) establishment of a driver module design based on the use of special-purpose integrated circuit chips to drive multiple phasors; (5) definition of an automatic assembly line utilizing proved techniques; and (6) formulation of cost estimates for large scale production of both the phasor and the array logic/driver circuits.

REPORT NO: AFML-TR-74-216  
ACCESS NO: 203,375  
TITLE: MANUFACTURING METHODS FOR SPINEL FERRITES  
FOR USE IN MICROWAVE TUBES

January 1975

AUTHOR(S): S. Besse, et al.  
CONTRACT NO: F33615-71-C-1947  
CONTRACTOR: Raytheon Company  
PROJECT MONITOR: J. Meulemans (AFML/LTE)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT:

The technology has been developed and demonstrated for incorporating high Curie temperature lithium spinel ferrites in microwave tubes. Manufacturing methods have been established for a 50-tube per month capacity for each process involved in producing ferrite assemblies for tube use. Protective encapsulation of spinel ferrites by arc-plasma deposition of a 0.003-0.004 in. coating of a mixture of MgO and  $MgAl_2O_4$  permitted spinel ferrites to survive high temperature brazing and tube bakeout processing of 450°C without degradation of the dielectric loss. Successful multiple-layered sputter metalization and Ag-Cu eutectic brazing to a copper waffled substrate was accomplished. The development and demonstration of the technology of incorporating spinel ferrites in microwave tubes, when taken in conjunction with the prior demonstration for garnet ferrites, shows the great flexibility that now exists in the selection of ferrites for diverse microwave tube applications.

REPORT NO: AFML-TR-74-228  
ACCESS NO: 203,884  
TITLE: PLATED WIRE MASS MEMORY ARRAY MANUFACTURING METHODS

January 1975

AUTHOR(S): R. White, J. Casement  
CONTRACT NO: F33615-73-C-5002  
CONTRACTOR: Sperry Univac  
PROJECT MONITOR: J. Garrett (AFML/LTE)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT:

The objective of this project is to establish manufacturing processes and techniques to reduce the cost of plated wire memory arrays for use in plated wire random access mass memory subsystems. Manufacturing processes have been developed for fabricating metal tunnel structures and for providing suitable insulation and adhesion of the metal tunnel structure assembly. Cost improvements have also been achieved through improved packaging of the memory plane and hybrid circuits on the memory plane. A partially populated unit based on these techniques has been constructed and tested successfully. This technology is now ready for system implementation as a ruggedized, medium speed, mass memory system.



AFML/LT

REPORT NO: AFML-TR-74-239  
ACCESS NO: 203,449  
TITLE: MANUFACTURING METHODS FOR 30mm DEPLETED URANIUM PENETRATORS  
AUTHOR(S): G. Gegel, D. Stellrecht, A. Hoffmanner  
CONTRACT NO: F33615-74-C-5109  
CONTRACTOR: Battelle Memorial Columbus Labs  
PROJECT MONITOR: S. Inouye (AFML/LTM)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: The objective of this program was to identify and demonstrate a metal working and a casting process offering the greatest potentials for low cost manufacturing of depleted-uranium alloy penetrators from the two alloys: U-0.75 percent Ti and U-0.75 percent Quad. This objective was achieved in two phases: Phase I - Cost Analyses to justify the selected processes and Phase II - Experimental Work to develop and demonstrate the selected processes for process verification and revision of the original cost analyses.

REPORT NO: AFML-TR-74-244  
ACCESS NO: 203,455  
TITLE: MANUFACTURING METHODS FOR LOW EMISSION GRID COATINGS FOR BARIUM ACTIVATED CATHODE VACUUM TUBES  
AUTHOR(S): W. Sain, W. Stuart  
CONTRACT NO: F33615-72-C-1328  
CONTRACTOR: Varian Associates  
PROJECT MONITOR: J. Meulemans (AFML/LTE)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: The methods, techniques, processes, and special equipment necessary for manufacturing electron tube grids with special emission-suppressing coatings were investigated and a pilot production capability was established. The coatings contained carbon and titanium and were applied to the grids in a glow discharge (ion plating) from gaseous carbon and titanium precursor. The grid coating strongly suppresses thermionic electron emission and secondary emission from cathode evaporants deposited on the grid and is compatible with BaSr oxide and tungsten dispenser cathodes. Environmental tests and 1000-hour life tests were performed on tetrodes with the coated grids and both oxide and dispenser cathodes. Primary grid emission (measured at 850°C) and secondary grid emission remained low throughout the 1000-hour life tests in the oxide-cathode and dispenser cathode tetrodes. There was no abnormal degradation in the cathode emission of the oxide; cathode tetrodes rose during life testing; after 1000 hours, the useful cathode emission density exceeded 5 amperes per square centimeter.

REPORT NO: AFML-TR-74-246  
ACCESS NO: 200,988  
TITLE: NOTCHING MACHINE MANUFACTURING METHODS  
AUTHOR(S): H. Johannesson  
CONTRACT NO: F33615-72-C-1653  
CONTRACTOR: New Hampshire Ball Bearings  
PROJECT MONITOR: W. Harris (AFML/LTM)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: The project objective was directed at performing the notch grinding operation of full complement bearings more efficiently and to obtain a higher level of quality relative to notch height relationship to the bottom of the ball groove. The work program involved the design and fabrication of a universal work holding fixture for notch grinding both inners and outers. The fixture design included the interfacing of an electronic in-process gaging system that determines and controls the stock removal during the grinding operation to insure that the

AFML/LT

proper notch height is achieved. Conversion elements were purchased to alter a Bryant B Racegrinder to a Bryant B Boregrinder. The conversion resulted in providing the necessary reciprocal grinding action instead of the plunge grind action associated with a Racegrinder. This, the final report, reviews the activities from 15 March 1972 through 30 September 1974 relating to: 1) the work holding fixture; 2) the electronic In-Process Gaging System; 3) the Solid State Controller; 4) the grinding results achieved relative to efficiencies and quality.

REPORT NO: AFML-TR-74-275  
ACCESS NO: 201,540 March 1975  
TITLE: MANUFACTURING METHODS FOR ENGINE BLADE REPAIR  
AUTHOR(S): D. Rutz  
CONTRACT NO: F33615-72-C-1178  
CONTRACTOR: Pratt & Whitney Aircraft  
PROJECT MONITOR: Lt. J. Hager (AFML/LTM)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: Large-size titanium material compressor blades are utilized in the entry stages of modern turbofan engines. These blades incur leading edge damage from objects drawn into the engine inlet. An investigative engineering program was conducted to determine cost-effective procedures for repair of fan blades made from Ti-8Al-1Mo-1V and Ti-6Al-4V. Procedures, tooling, and welding techniques were established for the use of welded-in repair segments in place of specific damaged areas on the blade leading edge. Both steady-state and pulsed-current plasma arc welds are recommended as cost-effective methods for segment installation. The repair technology, successfully demonstrated by a subcontractor and the prime contractor, is applicable to approximately 90% of all foreign-object damage on the leading edge of the subject blades. Metallurgical laboratory fatigue tests of repaired blades were successful, and engine testing is projected.

REPORT NO: AFML-TR-75-4, Vol. I, II  
ACCESS NO: 203,727 June 1975  
TITLE: MANUFACTURING METHODS PROGRAM, IMPATT DIODES  
AUTHOR(S): T. Midford, E. Benko, J. Benton  
CONTRACT NO: F33615-72-C-1837  
CONTRACTOR: Hughes Aircraft Co.  
PROJECT MONITOR: Capt. Anderson (AFML/LTE)  
PROJECT NO: 601-2  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: The primary objectives of this program were to establish manufacturing methods to assure reproducible, high yield, and low cost production of IMPATT diodes for use at microwave and millimeter wave frequencies. In order to achieve the program objectives, the program was divided into five phases. A yield and cost analysis indicated a significant improvement in all manufacturing yields and a resulting factor of ten reduction in the manufacturing cost of Ka-band diodes.

REPORT NO: AFML-TR-75-5  
ACCESS NO: 202,196 July 1975  
TITLE: HOT ISOSTATIC PRESSING OF Ti-6Al-4V  
POWDER FORGING PREFORMS  
AUTHOR(S): R. Peebles  
CONTRACT NO: F33615-72-C-1449  
CONTRACTOR: General Electric Co.  
PROJECT MONITOR: L. Clark (AFML/LTM)  
DIST. STATEMENT: U.S. Govt. Agencies Only

**ABSTRACT:** This report was concerned with the selection of one type of Ti-6Al-4V powder from four for the production of hot isostatically pressed (HIP) shaped preforms for subsequent forging to a jet engine disk configuration, and comparing the resulting properties to those of an As-HIP disk, and conventionally wrought material. The selection involved testing for powder characteristics, preferred parameters of 13 HIP parametric variations. The final properties were determined for three conditions: As-HIP; alpha plus beta forging, and conventional beta forging of shaped HIP powder preforms. Final property evaluation included room temperature and 600 F tensile properties, Charpy impact, notch-time-fracture, fracture toughness, high cycle fatigue (smooth and notched), low cycle fatigue, creep, stress rupture, crack growth rate, and metallography.

REPORT NO: AFML-TR-75-6  
 ACCESS NO: 200,652  
 TITLE: EFFECT OF BEARING DEFECTS  
 AUTHOR(S): C. Beecher  
 CONTRACT NO: F33615-72-C-1243  
 CONTRACTOR: MPB Corp.  
 PROJECT MONITOR: W. Harris (AFML/LTM)  
 DIST. STATEMENT: U.S. Govt. Agencies Only  
 ABSTRACT: This program determined the relationship between selected raceway surface defects and performance and life of miniature ball bearings. Nine defect types were tested at various levels: Comet-Tail, Dig-Nick, Dirt Brinell, Grind-Skip Lines, Impingement, Orange Peel, Pit, Scratch and "Liney" Finish. Bearing selected was 5/16 OD x 1/8 ID in tolerance grades ABEC1, ABEC 3, ABEC 7P. Performance tests included static torque, low speed running torque, and vibration. Conclusions are that performance characteristics were influenced to a greater degree than were bearing life times. A specification for defect limitation is presented based on performance and life test evaluation.

REPORT NO: AFML-TR-75-12  
 ACCESS NO: 203,799  
 TITLE: EXPLORATORY DEVELOPMENT OF MAGNETIC BUBBLE DOMAIN MATERIAL FOR APPLICATION IN AIR FORCE SOLID STATE MASS MEMORY SYSTEMS  
 AUTHOR(S): D. Heinz, M. Elliott, R. Henry, F. Stearns  
 CONTRACT NO: F33615-73-C-5017  
 CONTRACTOR: Rockwell International Corp.  
 PROJECT MONITOR: H. Garrett (AFML/LTE)  
 PROJECT NO: 7371  
 TASK NO: 737103  
 DIST. STATEMENT: Approved for public release; distribution unlimited.  
 ABSTRACT: The objectives of this program were to develop bubble domain materials which perform in a military environment and meet device goals of a bit density of 1M bit/in<sup>2</sup>, a data rate of 1 MHz and an operating temperature range of -25 to 75°C. All of these program objectives have substantially been met. For this program, the military environment was considered to consist of extremes of temperature, dynamic mechanical stress and radiation. Bubble device operation over the temperature range of -25 to 75°C was addressed in the design of garnet compositions. The effects of shock and vibration were explored on bubble domain garnet films and results were obtained that revealed the absence of potentially deleterious magnetomechanical effects. Several studies were carried out including (1) a correlation of wall mobility with FMR parameters, (2) the determination of the exchange constant for substituted garnet compositions, (3) an investigation of the incorporation of flux ions in bubble films grown by LPE, (4) an analysis of the influence of composition on bubble material properties, and (5) growth and characterization of gallium- and germanium-substituted garnet compositions.



AFML/LT

REPORT NO: AFML-TR-75-29  
ACCESS NO: 203,853  
TITLE: LOW COST BORON FILAMENT  
AUTHOR(S): H. DeBolt, V. Krukoni  
CONTRACT NO: F33615-74-C-5136  
CONTRACTOR: Avco Systems Div.  
PROJECT MONITOR: D. Starks (AFML/LTN)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: This program was aimed at circumventing the effects of the crack tip in boron filaments at high speed boosts, or, if not possible to do so, at determining the highest speed boost which could be achieved while maintaining an average filament strength of 400 ksi. The objective of speed boost was to reduce boron filament costs by increasing the production rate. The upper limit of VHF speed boosting was studied as a function of  $\text{BCl}_3/\text{H}_2$  ratio and gas flow for 4.0- and 5.6-mil filament production. It was found that a greater speed boost was permissible for 5.6-mil production than for 4.0-mil while maintaining average strengths at 400 ksi or greater. The quantitative results were that with the use of VHF-augmentation 4-mil boron production rate could be increased 30% and 5.6-mil filament could be increased by 50% before the crack tip flaw level reduced the strength below 400 ksi.

AD B 006 811 L  
January 1975

REPORT NO: AFML-TR-75-36  
ACCESS NO: 201,112  
TITLE: MANUFACTURING METHODS FOR BBB FIBER  
AUTHOR(S): E. Chenevey, H. Hanson, M. Sakowitz, M. Tan  
CONTRACT NO: F33615-72-C-1148  
CONTRACTOR: Celanese Corp.  
PROJECT MONITOR: D. Starks (AFML/LTN)  
PROJECT NO: 329-2  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: The purpose of this program was to establish manufacturing methods for poly(bisbenzimidazobenzophenanthrolinedione) (BBB) fibers by designing and operating a pilot plant with a production capability of thirty pounds per week. Specifications for raw materials were developed and successful operation of the molten antimony trichloride polymerization process was demonstrated in the pilot plant. Spinning development was limited by a lack of sufficient polymer. However, excellent quality spinning dopes were made in the pilot plant. Coupled with corrosion resistant spinning pumps, stable spinning was achieved over a period of 20 hours. Drawing, using the hot nitrogen tubes designed for PBI drawing, was much improved over previous furnace set-ups. A preliminary design for a 0.5MM pound per year plant based on this process was made.

April 1975

REPORT NO: AFML-TR-75-44  
ACCESS NO: 203,855  
TITLE: LASER DRILLING  
AUTHOR(S): L. M. Heglin  
CONTRACT NO: F33615-73-C-5006  
CONTRACTOR: General Electric Co.  
PROJECT MONITOR: J. Williamson (AFML/LTM)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: A project has been conducted to advance and demonstrate manufacturing methods for laser drilling small diameter holes with large depth to diameter ratios. The objectives of the program were to establish a cost effective, optimized small hole drilling process for current and future engine configurations, and to provide the engine industry with a high degree of confidence for the utilization of laser drilled holes in highly stressed components.

AD B 006 837 L  
April 1975

AFML/LT

REPORT NO: AFML-TR-75-62  
ACCESS NO: 203,854  
TITLE: SUPERPLASTIC FORMING OF TITANIUM STRUCTURES  
AUTHOR(S): C. Hamilton, G. Stracher, J. Mills, H. Li  
CONTRACT NO: F33615-73-C-5005  
CONTRACTOR: Rockwell International Corp.  
PROJECT MONITOR: J. Williamson (AFML/LTM)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: This program was directed at the establishment of superplastic forming of Ti-6Al-4V and Ti-6Al-2Sn-4Zr-2Mo alloys as a production process. Forming studies were pursued to evaluate the process parameters of superplastic forming and to extend the process to forming aircraft structural components. A detailed study was carried out on the effect of forming parameter variations with the two titanium alloys and two configurations. It was found that the degree of forming was directly related to time at pressure at elevated temperatures. Substantial cost savings were shown to be possible through the use of superplastic forming of titanium sheet metal by reducing overall fabrication time and by providing the capability to eliminate assemblies and producing simpler, more efficient, monolithic structures.

AD B 006 891 L  
April 1975

REPORT NO: AFML-TR-75-102  
ACCESS NO: 203,848  
TITLE: MANUFACTURING PROCESS FOR THE DENSIFICATION OF COMPLEX SHAPED WOVEN COMPOSITE PREFORMS  
AUTHOR(S): D. Wetzler  
CONTRACT NO: F33615-72-C-1665  
CONTRACTOR: McDonnell Douglas Astronautics  
PROJECT MONITOR: H. Materne (AFML/LTN)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: The purpose of this project was the development and establishment of a manufacturing process for the densification of low cost, quality woven preform carbon structures. The objective of this program was to provide manufacturing methods for: complete automation of the densification operation, continuous high speed packing fully coordinated with other loom operations, packing of weaving yarns to consistent and reproducible densities, capability for a wide range of densities and distortion-free packing of preforms. Accomplishment of these objectives has yielded a proven economical process capable of producing various interwoven, multidimensional composites, having a variety of end item materials, designs, and fabrication patterns.

July 1975

REPORT NO: AFML-TR-75-108  
ACCESS NO: 200,710  
TITLE: NONCONSUMABLE MELTING OF TITANIUM  
AUTHOR(S): G. D. Willette  
CONTRACT NO: F33615-72-C-1126  
CONTRACTOR: Teledyne Titanium  
PROJECT MONITOR: K. Love (AFML/LTM)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: Nonconsumable skull melting was evaluated as a titanium alloy production process for critical aerospace applications. Both titanium nitride and tungsten carbide inclusion defects were removed in melting through a gravity separation and entrapment in the skull mechanism. Numerous raw material forms including machining chips can be utilized, making the process cost effective. Turbine engine compressor disks made from nonconsumable melted material were evaluated and found to have acceptable quality and mechanical properties.

September 1975

AFML/LT

REPORT NO: AFML-TR-75-110  
ACCESS NO: 203,128 August 1975  
TITLE: MANUFACTURING METHODS FOR THERMAL EXPANSION  
MOLDING OF ADVANCED COMPOSITES AIRCRAFT STRUCTURE  
AUTHOR(S): W. Cremens  
CONTRACT NO: F33615-74-C-5150  
CONTRACTOR: Lockheed-Georgia  
PROJECT MONITOR: H. Reinert (AFML/LTN)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: The purpose of this contract is to establish a manufacturing method for fabrication and assembly of advanced composite primary aircraft structures that will be cost-competitive with comparable aluminum structures. The specific goals of this program are to (1) demonstrate and further develop an innovative molding process which uses elastomeric tooling to reduce fabrication and assembly costs while improving reproducibility, and (2) perform manufacturing process analysis and fabrication cost tracking to identify and reduce the high cost aspects and allow projections of the cost impact on production hardware.

REPORT NO: AFML-TR-75-111  
ACCESS NO: 202,878 July 1975  
TITLE: MANUFACTURING METHODS FOR FABRICATION AND  
ASSEMBLY OF ADVANCED COMPOSITE PRIMARY AIRCRAFT STRUCTURE  
AUTHOR(S): L. May, R. Goad  
CONTRACT NO: F33615-74-C-5086  
CONTRACTOR: General Dynamics Convair Div.  
PROJECT MONITOR: H. Reinert (AFML/LTN)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: A two-phase program was conducted to investigate process parameters and manufacturing techniques relevant to fabricating primary aircraft structure from advanced composite thermoformable material. Forming and joining techniques investigated in the preliminary phase were applied in the final phase to component fabrication. Six graphite/polysulfone strakes were fabricated for the YF-16 aircraft. The composite component is interchangeable with the metal component except for the fasteners used to attach the strake to the aircraft, and it weighs 40% less. Cost studies associated with the fabrication of graphite/polysulfone components revealed significant savings in labor. In a production run, tooling cost for graphite/polysulfone parts remains the same as for a limited number of parts. When this cost is amortized over a large production run it becomes a small portion of the total part cost. Added cost savings can result from raw material control and storage, and lower scrappage rates.

REPORT NO: AFML-TR-75-114 AD B 008 529 L  
ACCESS NO: 204,101 August 1975  
TITLE: MANUFACTURING METHODS TO PRODUCE HIGH DIELECTRIC  
CONSTANT MATERIALS FOR MICROWAVE APPLICATIONS  
AUTHOR(S): A. Paladino, L. Lesensky, H. Miller, et al.  
CONTRACT NO: F33615-73-C-5018  
CONTRACTOR: Raytheon Co.  
PROJECT MONITOR: E. Tarrants (AFML/LTE)  
DIST. STATEMENT: U.S. Govt. Agencies Only



AFML/LT

**ABSTRACT:** Manufacturing methods and facilities were established to produce low loss, temperature stable, high dielectric constant materials suitable for microwave device application such as beam forming networks for ECM radar, microwave integrated circuits, resonator-filters and ferrite phase shifters. Batches of 150 lbs. of barium tetratitanate (K-38) were produced. A split cavity technique was developed for non-destructive microwave evaluation of large-area K-38 substrates. The suitability of K-38 was successfully demonstrated for beam forming networks, microwave integrated circuits, and resonator-filters by fabricating and evaluating five samples of each. Good surface finish and low dielectric loss were thus shown.

**REPORT NO:** AFML-TR-75-115 **AD B 008 582 L**  
**ACCESS NO:** 201,787 **September 1975**  
**TITLE:** MANUFACTURING METHODS FOR RAPIDLY CURING  
ADVANCED COMPOSITES  
**AUTHOR(S):** J. Mahon, S. Richter, J. Kouchinsky  
**CONTRACT NO:** F33615-73-C-5036  
**CONTRACTOR:** Grumman Aerospace Corp.  
**PROJECT MONITOR:** P. Pirrung (AFML/LTN)  
**DIST. STATEMENT:** U.S. Govt. Agencies Only

**ABSTRACT:** The results of a sequential, three-phase program, beginning with a determination of the physical properties of RF-cured advanced composites and ending with a production demonstration of the established process are reported. In Phase I (process development), a production-size rapid curing facility was established. During Phase II (process demonstration), boron/epoxy F-14A horizontal stabilizer small bays and graphite/epoxy F-111A shoulder panels were successfully molded using 90-minute RF-curing cycles. In Phase III (RF curing of non-bleed matrix laminates), advanced composites with non-bleed matrices (polyarylsulfone thermoplastics) were formed at temperatures above 500 using RF energy and conventional bagging procedures. In Phase IV (cost effectiveness of the rapid curing process), cost studies were made which include processing and support equipment and required services for a production rapid curing facility, and power requirements for RF curing graphite/epoxy and boron/epoxy laminates selected thicknesses, were established.

**REPORT NO:** AFML-TR-75-145 **AD B 008 862 L**  
**ACCESS NO:** 203,059 **September 1975**  
**TITLE:** LOW COST MANUFACTURING CONCEPTS OF ADVANCED  
COMPOSITE PRIMARY AIRCRAFT  
**AUTHOR(S):** D. Stansbarger, et al.  
**CONTRACT NO:** F33615-74-C-5153  
**CONTRACTOR:** Northrop Corp.  
**PROJECT MONITOR:** T. Reinhart (AFML/LTN)  
**DIST. STATEMENT:** U.S. Govt. Agencies Only

**ABSTRACT:** Test data on the effects of the synergistic manufacturing methods on the mechanical, physical, and dimensional properties of the selected advanced composite system are reported under Task I. The synergistic manufacturing approach developed on this program was shown to be a viable cost competitive approach to the fabrication of fuselage structures. The integration of cocuring, vacuum pressure curing, no resin bleed, reusable rubber vacuum bags, and ion graphing techniques provides a production manufacturing approach which will reproducibly produce structurally sound graphite and graphite-fiberglass/epoxy hybrid primary aircraft structures on a cost competitive basis with their aluminum counterparts at a substantial weight savings. In concert with this cost savings is a concurrent weight savings of approximately 40 percent.

AFML/LT

REPORT NO: AFML-TR-75-150 AD B 008 691 L  
ACCESS NO: 204,102 October 1975  
TITLE: AUTOMATED DIRECTIONAL SOLIDIFICATION OF SUPERALLOYS  
AUTHOR(S): R. Kanaby, G. Vonnegut  
CONTRACT NO: F33615-74-C-5007  
CONTRACTOR: Detroit Diesel Allison Div.  
PROJECT MONITOR: G. Glenn, J. Elbaum (AFML/LTM)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: An 18 month, 2-phase program was conducted to establish a low-cost process suitable for automated production of directionally solidified air-foil castings. The basic casting process used in the program utilized an exothermic material for preheating molds, rather than induction mold heating apparatus commonly used. Phase I effort involved characterization and refinement of the basic process to a degree which ensured ultimate capability for commercial application. Phase II effort involved 28 molds of TF41 turbine blades and vanes, poured as a pilot production demonstration lot. Based on casting quality obtained, the process was judged capable of producing directionally solidified blades on a commercial scale at estimated cost no more than 90% greater than equiaxed casting costs.

REPORT NO: AFML-TR-75-174  
ACCESS NO: 204,123 October 1975  
TITLE: SUMMARY REPORT ON THE AIR FORCE/INDUSTRY COST  
REDUCTION PROGRAM RADAR PANEL, PHASE II  
AUTHOR(S): Staff Report  
CONTRACT NO: N/A  
CONTRACTOR: Boeing Co.  
PROJECT MONITOR: Maj. Bellem (AFML/LTE)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: The Radar Panel of the USAF/Industry Cost Reduction Program was sponsored by AFML and has identified 22 specific candidate cost reduction items to reduce the 25% upward spiral of radar system acquisition costs. This work has been done in two phases and this document summarizes the Phase I work that identified the high cost radar system elements as well as the Phase II work that identifies the specific cost reduction items.

NONMETALLIC MATERIALS DIVISION (AFML/MB)

REPORT NO: AFML-TR-70-278, Pt. V AD B 007 656 L  
ACCESS NO: 203,981 May 1975  
TITLE: HYBRID FLUOROSILICONES FOR AIRCRAFT FUEL  
TANK SEALANTS. SYNTHESIS OF FLUOROCARBON/  
FLUOROSILICONE HYBRID COPOLYMERS, PERFLUOROETHER  
OLIGOMERS AND RESIN HYBRID BLOCK COPOLYMERS  
AUTHOR(S): Y. Kim, M. Riley, G. Capps, P. Carter  
CONTRACT NO: F33615-74-C-5046  
CONTRACTOR: Dow Corning Corp.  
PROJECT MONITOR: W. Griffin (AFML/MBE)  
PROJECT NO: 7340  
TASK NO: 734005  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: The syntheses and evaluations of alternating copolymers  
having \*LS/FCS-210 ratios of 1/1, 1.5/1, and 2/1 have been accomplished. All  
of the copolymers are superior to LS in terms of high temperature reversion resis-  
tance, and their low temperature properties were considerably improved over those  
of the FCS-210 homopolymers. The preliminary evaluation results indicate that  
the random copolymer is somewhat less reversion resistant than the alternating  
copolymers. Peroxide vulcanization of a block copolymer produced an elastomer  
with good tensile strength and flexibility. Solvent extraction studies and  
behavior after vulcanization provided further information about the structure of  
the block copolymer products.

REPORT NO: AFML-TR-71-2 AD B 007 440 L  
ACCESS NO: 203,895 January 1975  
TITLE: POLYMER STRUCTURES AND PROPERTIES, PART IV,  
THERMALLY STABLE POLYMERS  
AUTHOR(S): G. Berry  
CONTRACT NO: F33615-70-C-1058  
CONTRACTOR: Carnegie-Mellon University  
PROJECT MONITOR: Dr. T. Helminiak (AFML/MBP)  
PROJECT NO: 7340  
TASK NO: 734004  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: Creep and recovery measurements of polybisbenzimidazobenzophenatholinedione (BBB) over the temperature interval 30 to 500°C (in vacuo) have been augmented by x-ray diffraction, isothermal construction, and solubility measurements. The principal mode of creep gives rise to fully recoverable Andrade creep for which the strain is proportional to the cuberoot of time. The stress-strain behavior of a material exhibiting Andrade creep (for which the creep compliance is linear in the cube-root of time) and the recoverable strain after the stress has been removed have been calculated for loading at constant strain rate  $\dot{\epsilon}$  and stress rate  $\dot{\sigma}$ . The results of the calculations are compared with the experimentation. Isochronal dynamic mechanical (10 Hz) measurements and differential scanning calorimetry are reported on films of BBB over the temperature range 100 to 500°C.



AFML/MB

REPORT NO: AFML-TR-71-24, Pt. IV  
 ACCESS NO: 203,297  
 TITLE: HIGH TEMPERATURE RESISTANT ELASTOMERS OR COMPLIANT POLYMERS  
 AUTHOR(S): R. Jones, H. Cassey, C. Bertino  
 CONTRACT NO: F33615-71-C-1397  
 CONTRACTOR: TRW Systems  
 PROJECT MONITOR: T. Graham (AFML/MBE)  
 DIST. STATEMENT: U.S. Govt. Agencies Only  
 ABSTRACT: This report describes the exploratory development and evaluation of elastomeric or compliant polyimides as integral fuel tank sealant for use over wide temperature (ultimate -65° to 600°F) ranges. Polymer based on bis (3,4-carboxyphenoxyphenyl) sulfone dianhydride (BSDA), 4,4'-methylene dianiline (MDA), diaminostilbene (DAS) and 1000 mol. wt. polyaliphatic ether diamine (PED) intermediate exhibited promise as a 40° to 450°F sealant, but efforts to formulate a high solids processable sealant system were unsuccessful. A similar polymer which utilized an aminophenyl terminated perfluoroether oligomer as the flexible polymer segment was found to be compliant and thermally stable in JP-7 fuel and N<sub>2</sub> at temperatures up to 550°F. Additional data is required to determine whether or not this type of polymer is non-corrosive to titanium, adheres adequately to this type of substrate, and if it is amenable to formulating a high solid processable sealant system.

AD B 001 146 L  
 August 1974

REPORT NO: AFML-TR-72-142, Pt. III  
 ACCESS NO: 203,409  
 TITLE: HIGH TEMPERATURE THERMALLY STABLE GREASES  
 AUTHOR(S): A. Dobry, et al.  
 CONTRACT NO: F33615-71-C-1439  
 CONTRACTOR: Amoco Oil Co.  
 PROJECT MONITOR: J. Christian (AFML/MBT)  
 DIST. STATEMENT: U.S. Govt. Agencies Only  
 ABSTRACT: Friction modifiers in grease made by thickening Krytox 143 AD fluid with AMT-9 did not improve bearing life. Different preparations of AMT-9 gave greases in Krytox 143 AD with different test lives. The coarsest preparation of AMT-9 gave a grease with the longest bearing life. Three different polyphenylenes gave greases from F6-7039 fluid with poor bearing lives but gave greases from Krytox 143 AD fluid with good bearing lives. Addition of F6-7039 fluid improved thickener efficiency of greases from two of these thickeners in Krytox 143 AD.

AD B 002 787  
 March 1975

REPORT NO: AFML-TR-72-179, Pt. III  
 ACCESS NO: 203,434  
 TITLE: THERMOCHEMICAL ABLATION OF AROMATIC/HETEROCYCLIC POLYMERIC COMPOSITES, PART III: MATERIAL ELEMENTAL COMPOSITION PERFORMANCE OPTIMIZATION  
 AUTHOR(S): H. Tong, et al.  
 CONTRACT NO: F33615-71-C-1490  
 CONTRACTOR: Acurex Corp.  
 PROJECT MONITOR: R. Farmer (AFML/MBT)  
 DIST. STATEMENT: U.S. Govt. Agencies Only  
 ABSTRACT: Previous studies have developed a thermochemical predictive technique which has been shown to be a reliable method of predicting ablative response of carbon reinforced polymer composites. This study investigates the adequacy of this technique in predicting the response of a wider range of inter-metallic, non-metallic, and metallic materials. The technique is extended to a computer code which is capable of optimizing on composite material composition in order to minimize ablation rates.

October 1974

AFML/MB

REPORT NO: AFML-TR-72-191, Pt. III AD B 000 726 L  
ACCESS NO: 203,218 October 1974  
TITLE: MATERIALS AND APPROACHES FOR IMPROVED STRESS  
CORROSION INHIBITIVE COATINGS  
AUTHOR(S): C. Mitchell, G. Hurley  
CONTRACT NO: F33615-74-C-5016  
CONTRACTOR: Tyco Laboratories, Inc.  
PROJECT MONITOR: D. Prince (AFML/MBE)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: Stress-corrosion prevention systems for high strength  
aluminum alloys are primarily aimed at the exclusion of the corrosive environment  
from the metal surface. In those cases, however, it is known that the loss of  
integrity in the coating leads to failure by SCC. In previous work we have shown  
that stress corrosion can be controlled by means of anodized coatings formed by  
anodization in molten nitrate baths. In the present case, the conditions for car-  
rying out the anodization treatments were optimized to yield more uniform and  
reproducible films. Further process variables, anodization time, and impregnation  
procedures were also investigated to give maximum protection. Finally, the effect  
of the coating on fatigue and corrosion fatigue was determined and compared to MIL  
Spec anodized coatings.

REPORT NO: AFML-TR-72-223, Pt. III AD B 001 047 L  
ACCESS NO: 203,294 September 1974  
TITLE: ADVANCED REENTRY MISSILE HEATSHIELD MATERIALS,  
PART III: HIGH STRAIN/STRENGTH FIBER MULTIDIRECTIONAL  
REINFORCED THERMALLY STABLE MATRIX COMPONENTS  
AUTHOR(S): P. Roy, et al.  
CONTRACT NO: F33615-71-C-1659  
CONTRACTOR: Avco Government Products Group  
PROJECT MONITOR: R. Farmer (AFML/MBE)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: The report summarizes the results of exploratory materials  
development evaluations undertaken for the development of high strain/strength  
fiber reinforced thermally stable matrix composites. The feasibility of processing  
Avco 3D composite materials constructed of high strain/strength Thornel 300/  
Thornel 400 in combination with Ciba-Geigy P105A polyimide resin was investigated.  
Exploratory resin processing and materials fabrication evaluations as related to  
radial/lateral material fabrication and matrix densification were undertaken. Tech-  
niques for pregging the high strain/strength reinforcements with P105A resin for  
use in molding of unidirectional composites for use as radial material and for use  
in fabricating prepregged tape for lateral (hoop and axial) winding were developed.

REPORT NO: AFML-TR-72-229, Pt. III AD B 001 433 L  
ACCESS NO: 203,295 August 1974  
TITLE: DEVELOPMENT OF HIGH TEMPERATURE FUNCTIONAL FLUIDS  
AUTHOR(S): B. Hamon, T. Psarras  
CONTRACT NO: F33615-71-C-1406  
CONTRACTOR: PCR, Inc.  
PROJECT MONITOR: C. Snyder (AFML/MBT)  
DIST. STATEMENT: U.S. Govt. Agencies Only

**ABSTRACT:** The photochemical oxidation of hexafluoropropylene was studied. The method was developed to a continuous process yielding a mixture of carbonyl fluoride oligomers of the structure  $\text{CF}_3\text{O}(\text{CF}_2\text{O})_m\text{CF}_2\text{COF}$  and  $\text{CF}_3\text{O}(\text{CF}_2)_m\text{COF}$ . Treatment of this mixture with catalytic amounts of potassium fluoride was found to effectively decompose the fluoroformate terminated oligomers, thus leaving a mixture of acyl fluoride oligomers which can be separated by fractional distillation. The addition of hexafluoropropylene oxide to carbon fluoride oligomers was studied and a series of acyl fluorides of the structure  $\text{CF}_3\text{O}(\text{CF}_2\text{O})_m\text{CF}_2\text{CF}_2\text{O}[\text{CF}(\text{CF}_3)\text{CF}_2\text{O}]_n\text{CF}(\text{CF}_3)\text{COF}$  was prepared. A series of s-triazines derived from these oligomers was prepared. These triazines exhibit lower pour points by 30-50° F than equivalent triazines derived from TFEO or HFPO.

REPORT NO: AFML-TR-72-290  
 ACCESS NO: 203,359 November 1974  
 TITLE: HYDROFLUOROCARBON SEALANTS WITH IMPROVED LOW TEMPERATURE AND STRESS CORROSION PROPERTIES  
 AUTHOR(S): W. Anspach  
 CONTRACT NO: N/A  
 CONTRACTOR: internal  
 PROJECT MONITOR: W. Anspach (AFML/MBE)  
 DIST. STATEMENT: Approved for public release; distribution unlimited.  
 ABSTRACT: Hydrofluorocarbon integral fuel tank sealants have been prepared which exhibit significantly improved low temperature and stress corrosion properties. These sealants should have a useful temperature range of -50° F to +550° F in hydrocarbon fuel environments. The base polymer for these Air Force Materials Laboratory (AFML) developed sealants is an experimental hydrofluorocarbon elastomer, LD-487LV, by the E.I. du Pont de Nemours Company. This report discusses compounding effects, evaluation of adhesion enhancement techniques, and a basic investigation of the stress corrosion susceptibility of titanium substrates in contact with the sealants and compounding ingredients contained in them. Data is presented and discussed which demonstrates both the advantages and limitations of these fuel tank sealing materials.

REPORT NO: AFML-TR-73-90, Pt. II AD B 000 946 L  
 ACCESS NO: 203,217 October 1974  
 TITLE: LONG LIFE ELASTOMERIC AIRCRAFT HYDRAULIC SEALS  
 AUTHOR(S): K. Miller, K. Ksieski, L. Hiltner  
 CONTRACT NO: F33615-73-C-5122  
 CONTRACTOR: Parker Hannifin Corporation  
 PROJECT MONITOR: R. Headrick (AFML/MBE)  
 DIST. STATEMENT: U.S. Govt. Agencies Only  
 ABSTRACT: The continued development work of long life elastomeric hydraulic seals for -65° F to +450° F/4000 psig service has shown very encouraging results. By optimizing compounds, which were based on commercially available elastomers, it has been possible to meet several goals within this temperature range. Initial results indicate that greatly improved broad temperature range seals can be developed through compound improvement of the low temperature experimental fluorocarbon elastomers by increasing extrusion resistance and reducing high temperature compression set. This approach coupled with the development of improved anti-extrusion devices will be investigated.



AFML/MB

REPORT NO: AFML-TR-73-119, Pt. II  
ACCESS NO: 203,209  
TITLE: SYNTHESIS OF NEW SEMI-ORGANIC POLYMERS  
AUTHOR(S): L. Breed, J. Wiley, Jr.  
CONTRACT NO: F33615-72-C-1627  
CONTRACTOR: Midwest Research Institute  
PROJECT MONITOR: Dr. H. Rosenberg (AFML/MBP)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: Methods of synthesis were developed for phenyl-substituted, siloxane-modified polybenzimidazoles and polybenzoxazoles. The polymers were characterized, their solubilities determined in various solvents, and thermo-oxidative stabilities examined. Suitable procedures could not be developed for the synthesis of precursors for the corresponding polypyromellitimides. The preparation and properties of monomers, intermediates, and model compounds for each of the three polymer systems are reported.

AD B 000 589 L  
June 1974

REPORT NO: AFML-TR-73-147, Pt. II  
ACCESS NO: 203,205  
TITLE: GRAPHITE FIBERS FROM PITCH  
AUTHOR(S): R. Didchenko  
CONTRACT NO: F33615-71-C-1538  
CONTRACTOR: Union Carbide Corp.  
PROJECT MONITOR: W. Gloor (AFML/MBC)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: Methods to measure molecular weight distributions in MP pitches have been developed. Number and weight average molecular weights and their distributions have been determined as a function of P.I., in MP pitches. Significant progress has been achieved during this report period both in the art of spinning very thin MP pitch filaments and in the understanding of structural changes that take place during the conversion of pitch fibers to high-performance carbon fibers. The properties of the carbonized monofilament in some instances exceeded the target properties.

AD B 000 591 L  
March 1974

REPORT NO: AFML-TR-73-147, Pt. III  
ACCESS NO: 204,004  
TITLE: GRAPHITE FIBERS FROM PITCH  
AUTHOR(S): R. Didchenko  
CONTRACT NO: F33615-71-C-1538  
CONTRACTOR: Union Carbide Corp.  
PROJECT MONITOR: W. Gloor (AFML/MBC)  
PROJECT NO: 7320  
TASK NO: 73200135  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: The properties of the multifilament yarn improved over those achieved in the past. Strand tensile strength of up to 2.30 GPa (~350 Kpsi) was measured on fibers with an elastic modulus of 200 GPa (~30 Mpsi). Tests on flat plate composites with epoxy indicated good translation of properties if corrections were made for insufficient fiber loading. The absolute tensile strength of the thin monofilament did not exceed the levels reported in the previous report, but reliable average values in excess of 3.45 GPa (~500 Kpsi) were obtained on filaments with elastic moduli of 300 GPa (45 Mpsi). The monofilament, with random or onion-skin structure, was in most respects similar to "Thornel" yarn, appeared to contain between the oriented ribbons a carbon phase which was considerably more susceptible to oxidation than the ribbons themselves. So far, only gas bubbles and some surface flaws have been identified as major structural defects in Type-P fibers.

July 1975

AFML/MB

REPORT NO: AFML-TR-73-171, Pt. II  
ACCESS NO: 203,412  
TITLE: NOVEL BLOCK COPOLYMERS  
AUTHOR(S): P. Juliano, T. Mitchell  
CONTRACT NO: F33615-72-C-1523  
CONTRACTOR: General Electric Co.  
PROJECT MONITOR: Dr. H. Rosenberg (AFML/MBP)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: The synthesis of block polymer elastomers containing poly (2,6-diphenyl-1,4-phenylene oxide) [ $P_3O$ ] hard segments and poly [3-hepta-fluoroisopropoxypropyl-methylsiloxane] [FES] soft segments was accomplished. Factors affecting the synthesis of these  $P_3O$ -FES block polymers were the difunctionality of disiloxanol-terminated FES oligomers, the structure of the amino-silane coupling agent, the polymerization temperature, and the solids level during polymerization. The resulting  $P_3O$ -FES block polymer elastomers (FES derived from  $M_5R$  cyclic trimer) exhibited better tensile properties than comparable silica-filled heat-cured FES ( $M_5R$ ) elastomers. Solvent resistance and thermal stability were below anticipated levels for these materials.

AD B 001 297 L  
August 1974

REPORT NO: AFML-TR-73-199, Pt. II  
ACCESS NO: 204,003  
TITLE: RADIANT HEATING OF AEROSPACE MATERIALS PT II:  
LASER EFFECTS PREDICTION PROCEDURE CODE  
AUTHOR(S): J. Ferrell, H. Tong, et al.  
CONTRACT NO: F33615-72-C-1774  
CONTRACTOR: Aerotherm Division/Acurex Corp.  
PROJECT MONITOR: R. Farmer (AFML/MBP)  
PROJECT NO: 7342  
TASK NO: 734202  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: A procedure for predicting the response of metals and nonmetals to laser heating was developed. This procedure makes use of computer codes which were developed for reentry vehicle ablation studies and were sufficiently general so that they could be modified for radiation dominated heating at flux levels which are representative of current and anticipated laser sources. The results of this development is the Aerotherm Prediction Procedure for Laser Effects code.

June 1975

REPORT NO: AFML-TR-73-242, Pt. II  
ACCESS NO: 203,459  
TITLE: DEVELOPMENT OF BEARING AND LUBRICANT TEST EQUIPMENT  
AUTHOR(S): J. Kissel, R. Stockwell, et al.  
CONTRACT NO: F33615-73-C-5087  
CONTRACTOR: Battelle  
PROJECT MONITOR: R. Bensing (AFML/MBT)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: Two experimental apparatuses have been designed, constructed, and delivered to the Air Force Materials Laboratory. These apparatuses will be used to develop experimental data which can be used to devise accelerated life tests for bearings for mechanically despun antenna drive systems for Air Force communications satellites. The two apparatuses were designed for the purposes of studying lubricant torque variations and lubricant quantity in ball bearings operating in vacuum.

AD A 004 843  
September 1974

REPORT NO: AFML-TR-73-275 AD B 001 822L  
ACCESS NO: 203,347 August 1974  
TITLE: IMPROVED ATJS GRAPHITE, Pt. I MATERIALS  
AND PROCESS STUDIES  
AUTHOR(S): J. Criscione, J. Fisher, R. Booth  
CONTRACT NO: F33615-72-C-1939  
CONTRACTOR: Union Carbide Corporation  
PROJECT MONITOR: J. Latva (AFML/MBG)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: Changes in the particle size distribution of the molding mixture, thermal treatment of the base filler particles, and the mixing and forming operation for the manufacture of grade ATJS graphite were investigated in an attempt to improve its tensile strength and strain-to-failure. As a result of these investigations, modifications were made in the ATJS manufacturing process which provided a 16-percent increase in tensile strength and a 24-percent increase in strain-to-failure over that of production Grade ATJS graphite.

REPORT NO: AFML-TR-73-280  
ACCESS NO: 203,356 January 1975  
TITLE: COMPUTER ANALYSIS OF THE MASS SPECTRA OF GAS MIXTURES  
AUTHOR(S): I. Goldfarb, R. Pritchard  
CONTRACT NO: N/A  
CONTRACTOR: internal  
PROJECT MONITOR: Dr. Goldfarb (AFML/MBP)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: Thermally stable polymeric materials are critically needed for development into new plastics, composites, fibers, adhesives, coatings, and elastomers for potential use in future Air Force systems under extreme environments. One means of studying the effects of high temperature on such materials is to subject them to a controlled thermal environment and to observe the resulting weight loss and evolved gases as a function of elapsed time and temperature change. A compositional analysis of the gases, along with weight loss data, is indispensable in formulating mechanisms for the degradation that results from this environment. This report describes the development of a complex computer package which can be utilized to solve the extremely difficult problem of analyzing gas mixtures from their mass spectra.

REPORT NO: AFML-TR-74-195 AD A 004 200  
ACCESS NO: 203,255 October 1974  
TITLE: DETERMINATION OF CHANGES IN LUBRICANT VISCOSITIES  
AT HIGH PRESSURES AND TEMPERATURES  
AUTHOR(S): A. Bossert, V. Hopkins  
CONTRACT NO: F33615-73-C-5069  
CONTRACTOR: Midwest Research Institute  
PROJECT MONITOR: F. Brooks (AFML/MBT)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: Absolute viscosity, kinematic viscosity, density, and secant bulk modulus values determined for seven lubricating fluids are presented. The determinations were made with falling weight viscometer at temperatures of 100°, 210°, and 300° F. and at pressures ranging from atmospheric to 160,000 psi. Plots of absolute viscosity and density are given and all results are discussed. The equipment used to make the determinations is described and the procedures followed to collect data and reduce to fluid property values are outlined.



AFML/MB

REPORT NO: AFML-TR-74-196, Pt. I AD B 001 823 L  
ACCESS NO: 203,306 September 1974  
TITLE: MATERIALS VARIABLES AFFECTING THE IMPACT  
RESISTANCE OF GRAPHITE AND BORON COMPOSITES  
AUTHOR(S): R. Novak  
CONTRACT NO: F33615-73-C-5090  
CONTRACTOR: United Aircraft Corp.  
PROJECT MONITOR: G. Husman (AFML/MB)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: This report describes the first year's efforts in which the impact resistance of boron and graphite reinforced resin matrix composites was to be studied and optimized. During the first task the effect of several material variables on impact behavior was examined using 5.6 mil boron/PR-286 epoxy as the reference material. Static properties, as well as Charpy and ballistic impact response, were measured for all materials. Of the materials variables investigated, the fiber characteristics and the interfacial fiber-matrix bond strength were found to play important roles in the impact response of the composites. Two approaches were investigated for improving the impact behavior of the composites: hybridization of the reinforcement in which boron and S-glass were combined, and utilization of thermoplastic matrix resins having greater energy absorbing ability than commonly used epoxies.

REPORT NO: AFML-TR-74-196, Part II AD B 007 239 L  
ACCESS NO: 203,894 June 1975  
TITLE: MATERIALS VARIABLES AFFECTING THE IMPACT RESISTANCE  
OF GRAPHITE AND BORON COMPOSITES, PART II  
AUTHOR(S): R. Novak  
CONTRACT NO: F33615-73-C-5090  
CONTRACTOR: United Technologies Corp.  
PROJECT MONITOR: G. Husman (AFML/MB)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: This report describes the impact resistance of boron and graphite reinforced specimens to be optimized. The results of a series of static and normal ballistic impact tests on graphite hybrids with epoxy and polysulfone matrices and on a boron hybrid with polysulfone matrix are described. It is demonstrated that the best impact resistance is obtained with carbon/glass/polysulfone and boron/glass/polysulfone. Testing of these and several other materials under impact conditions more closely simulating those encountered by gas turbine engines is described. Again the same two materials are shown to have the best overall performance. Finally, the effects of through-thickness reinforcement and metallic sheaths as impact protection schemes are discussed.

REPORT NO: AFML-TR-74-199 AD B 001 643 L  
ACCESS NO: 203,337 November 1974  
TITLE: SYNTHESIS OF HIGH MOLECULAR WEIGHT "PARA"-  
PHENYLENE PBI  
AUTHOR(S): Dr. R. Kovar, Dr. F. Arnold  
CONTRACT NO: N/A  
CONTRACTOR: internal  
PROJECT MONITOR: Dr. F. Arnold  
DIST. STATEMENT: U.S. Govt. Agencies Only

AFML/MB

**ABSTRACT:** A new class of aromatic polyamide materials has recently become commercially available which exhibit super mechanical properties. The properties are primarily connected to the all-"para" aromatic structure of these polyamides. This report is concerned with the synthesis of an all-"para" aromatic heterocyclic polymer system.

REPORT NO: AFML-TR-74-201, Pt. I AD A 009 515  
ACCESS NO: 203,484 June 1974  
TITLE: FLUIDS, LUBRICANTS, FUELS, AND RELATED MATERIALS  
AUTHOR(S): E. Klaus, et al.  
CONTRACT NO: F33615-73-C-5101  
CONTRACTOR: Penn. State U.  
PROJECT MONITOR: G. Morris (AFML/MBT)  
PROJECT NO: 7343  
TASK NO: 734303  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
**ABSTRACT:** Oxidation studies with a variety of fluids at high temperatures are presented. These studies emphasize the evaluation of oxygen tolerance of the fluids as opposed to conventional tests measuring the stable life or induction period of fluids. A lubrication model based on metal-fluid interaction in the concentrated contact is proposed. Environmental conditions in the concentrated contact are shown to be capable of providing fluid degradation products. Some preliminary data on the effect of several materials on the wear behavior of steel-on-titanium and titanium-on-titanium are presented. Bulk modulus measurements for some Spec. MIL-H-83282 are given.

REPORT NO: AFML-TR-74-208, Pt. I AD A 007 851  
ACCESS NO: 203,416 November 1974  
TITLE: WATER-BASE COATINGS  
AUTHOR(S): M. El-Aaser, et al.  
CONTRACT NO: F33615-73-C-5179  
CONTRACTOR: Lehigh University  
PROJECT MONITOR: D. Prince (AFML/MBE)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
**ABSTRACT:** The purpose of this work was to develop water-based analogs of existing solvent-based epoxy primer and polyurethane topcoat systems. The approach was to prepare aqueous emulsions of both epoxy and polyurethane system components using the anionic sodium lauryl sulfate-cetyl alcohol or cationic hexadecyl-trimethylammonium bromide-cetyl alcohol combinations as emulsifier. The preparation of polyurethane emulsions is complicated by the reactivity of the isocyanate groups with water. Therefore, the isocyanate prepolymer was pre-reacted to give adducts that were emulsified using the anionic mixed emulsifier combination and simple stirring, followed by ultrasonic irradiation of homogenization. Both fully-cured and air-drying adducts gave fluid, stable emulsions which dried to tough, flexible films.

REPORT NO: AFML-TR-74-218 AD B 004 283 L  
ACCESS NO: 203,574 January 1974  
TITLE: INVESTIGATION OF CONTAMINATION EFFECTS ON THERMAL CONTROL  
AUTHOR(S): T. Hughes, et al.  
CONTRACT NO: F33615-73-C-5091  
CONTRACTOR: McDonnell Douglas Astronautics Co.  
PROJECT MONITOR: Lt. B. Price (AFML/MBE)  
DIST. STATEMENT: U.S. Govt. Agencies Only

ABSTRACT: Results are described of highly precise measurements of deposition rates of polymeric contaminants on various types of thermal control surfaces, and their subsequent reevaporation rates under a simulated space environment. Results are also presented on the changes in bidirectional reflectance of gold mirror due to contamination and subsequent irradiation by ultraviolet energy and electrons and protons. The effect of contamination and radiation on the hemispherical reflectance and solar absorptance of second surface mirrors was also studied. The presence of radiation was found to have a profound influence on contamination kinetics, and some totally unexpected results occurred in the bidirectional reflectance measurements of the gold mirrors as they warmed from cryogenic temperatures.

REPORT NO: AFML-TR-74-222 AD B 005 700 L  
 ACCESS NO: 203,750 March 1975  
 TITLE: THERMAL FLASH RESISTANT IR SUPPRESSION COATINGS FOR ADVANCED AIRCRAFT SYSTEMS  
 AUTHOR(S): J. Weaver  
 CONTRACT NO: N/A  
 CONTRACTOR: internal  
 PROJECT MONITOR: J. Weaver (AFML/MBE)  
 DIST. STATEMENT: U.S. Govt. Agencies Only  
 ABSTRACT: New and improved aircraft exterior coatings which offer a substantial increase in thermal flash resistance and reduced infrared emittance have been developed for use on high performance aircraft. The new coating systems, based on specially developed pigment materials, offer a 50-percent reduction in IR emittance compared to current state-of-the-art Mil-Spec coating systems over a wide spectral region encompassing both IR suppression and nuclear thermal flash wavelengths. Coating parameters and characteristics such as pigments, binders, pigment-volume-concentration, cure characteristics, purity, coating thickness, physical and optical properties were investigated. Particular attention was devoted to reducing cost and weight along with evaluating cleanability, weatherability, and ease of application. These coatings show great promise of meeting Air Force operational requirements.

REPORT NO: AFML-TR-74-230 AD B 003 573 L  
 ACCESS NO: 203,535 December 1974  
 TITLE: POLYFUNCTIONAL FLUOROCARBON DERIVATIVES FOR CHEMICAL RESISTANT ELASTOMERS AND CROSSLINKING SYSTEMS  
 AUTHOR(S): T. Keller, R. Checkosky, P. Tarrant  
 CONTRACT NO: F33615-72-C-1333  
 CONTRATOR: University of Florida  
 PROJECT MONITOR: J. Sieron (AFML/MBE)  
 PROJECT NO: 7340  
 TASK NO: 734005  
 DIST. STATEMENT: U.S. Govt. Agencies Only  
 ABSTRACT: Trifluorovinyl trifluoromethyl ketone,  $\text{CF}_2=\text{CFCCF}_3$  was prepared in a multi-step synthesis and a small sample sent to PCR, Inc. for incorporation into a nitroso elastomer. Other  $\alpha, \beta$ -unsaturated carbonyl compounds made were  $\text{CF}_2=\text{CClCCF}_3$ ,  $\text{CF}_2=\text{C}(\text{CH}_3)\text{CCF}_3$ ,  $(\text{CF}_3)_2\text{C}=\text{CClCF}$ ,  $(\text{CF}_3)_2\text{C}=\text{CClCO}_2\text{C}_2\text{H}_5$ , and  $(\text{CF}_3)_2\text{C}=\text{C}(\text{CF}_3)\text{CF}$ . Unsuccessful attempts were made with elemental fluorine in order to fluorinate  $\text{CF}_3\text{CCH}_2\text{CH}_3$  or to convert  $\text{CF}_3\text{CCl}_2\text{CCF}_3$  to  $\text{CF}_3\text{CCF}_2\text{CCF}_3$ . Unsuccessful attempts were made to oxidize compounds with  $-\text{C}(\text{CF}_3)_2$  groups to ketones or to hydrolyse compounds containing  $-\text{CFI}-$ ,  $-\text{CCl}_2-$ , or  $-\text{CClI}-$  groups to ketones.



AFML/MB

REPORT NO: AFML-TR-74-243 AD A 016 474  
ACCESS NO: 203,851 May 1975  
TITLE: INFERRING MECHANICAL RELAXATION SPECTRA, AN ILL-POSED PROBLEM  
AUTHOR(S): D. Wiff, M. Gehatia  
CONTRACT NO: N/A  
CONTRACTOR: internal  
PROJECT MONITOR: M. Gehatia (AFML/MBP)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: An effort is made to reduce the number of required mechanical measurements on resin, plastic, and composite specimens. This is achieved by proposing a technique for handling the ill-posed problem of determining a mechanical structural model of a specimen. The results are very encouraging. The report describes in detail the mathematical approach but also presents illustrative graphs comparing assumed mechanical relaxation distributions with those inferred from computer generated experimental data.

REPORT NO: AFML-TR-74-245 AD A 015 802  
ACCESS NO: 203,892 December 1974  
TITLE: DYNAMICS AND STATIC EVALUATION OF  
EXPERIMENTAL FUEL TANK SEALANT MATERIALS  
AUTHOR(S): J. Baker  
CONTRACT NO: F33615-72-C-1594  
CONTRACTOR: Dow Corning Corp.  
PROJECT MONITOR: W. Anspach (AFML/MBE)  
PROJECT NO: 7340  
TASK NO: 734005  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: This final technical report describes the investigation and evaluation of experimental integral fuel tank sealants under laboratory conditions simulating aircraft integral fuel tanks. Materials investigated were Dow Corning 77-028, 77-085, 3M Polyester, TRW Polyimide, Polysulfide, and AFML Viton. These materials were evaluated dynamically in a fillet sealed configuration. This report also describes in detail the functions, operational and problems encountered with the dynamic test apparatus that has been designed and fabricated for the purpose of evaluating experimental aircraft integral fuel tank sealants.

REPORT NO: AFML-TR-74-247 AD A 014 808  
ACCESS NO: 203,680 April 1975  
TITLE: DEVELOPMENT OF A GAS TURBINE ENGINE OIL FOR  
BULK OIL TEMPERATURES OF -40 TO 465°F  
AUTHOR(S): F. Clark, D. Miller, S. Reid  
CONTRACT NO: F33615-73-C-5079  
CONTRACTOR: Monsanto Research Corp.  
PROJECT MONITOR: G. Morris (AFML/MBT)  
PROJECT NO: 7343  
TASK NO: 734303  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: Reformulation of a developmental MIL-L-27502 ester lubricant - MCS 1034A - was undertaken to produce an improved oil of greater oxidation resistance and longer shelf life. Two new formulations resulted in: (a) An oil with oxidative stability similar to the reference ester at 428°F, but with improved stability at 464°F. After 72 hours at 464°F the viscosity increase of the new fluid is only one-half that of the reference; the acid number is about one-third that of the reference; (b) An oil with oxidative properties comparable to the reference ester but with improved storage life. Five gallons of fluid (a) were blended and forwarded to WPAFB for further evaluation.

AFML/MB

REPORT NO: AFML-TR-74-248, Part I AD B 008 032 L  
ACCESS NO: 204,009 January 1975  
TITLE: ADVANCED ABLATIVE HEATSHIELDS FOR REENTRY MISSILES,  
PART I: LOW RECESSION/HIGH STRENGTH PIQ MATRIX  
FABRICATION STUDY  
AUTHOR(S): C. Hughes  
CONTRACT NO: F33615-73-C-5128  
CONTRACTOR: Avco Government Products Group  
PROJECT MONITOR: R. Farmer (AFML/MBG)  
PROJECT NO: 7340  
TASK NO: 7340001  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: A PIQ heterocyclic resin was selected for this study. The reinforcement (in the form of a tow) can be successfully impregnated in a continuous fashion in a vertical prepreg oven. Both Pyralin RK-5081 (polyimide) and AFR-520 resin itself can be processed effectively as fiber sizes and are compatible with the high temperature curing requirements. The procedures worked out for the slat winding method of composite construction with the "as-received" resin were not successful for NOL ring filament winding geometry.

REPORT NO: AFML-TR-74-249 AD A 011 645  
ACCESS NO: 203,572 April 1975  
TITLE: APPARATUS AND TECHNIQUES USED FOR CASTING  
FILMS OF AROMATIC HETEROCYCLIC POLYMERS  
AUTHOR(S): M. Gehatia, A. Wereta, D. Wiff  
CONTRACT NO: N/A  
CONTRACTOR: internal  
PROJECT MONITOR: Capt. A. Wereta (AFML/MBP)  
PROJECT NO: 7340  
TASK NO: 734004  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: Techniques have been developed to convert raw polymers into films by casting from solutions and evaporating to dryness. One instrument has been developed to form films from highly volatile solvents and another to form films from corrosive nonvolatile solvents. Formed films underwent post-treatment such as leaching, drying, and thermal treatment. Inducing orientation by stretching has been attempted. Film structure has been investigated with x-ray diffraction. Preliminary work included films cast from BBB, PBI, and AB-PBI polymers. Casting (high strength) PRD-49 films was attempted without success.

REPORT NO: AFML-TR-74-256, Pt. I AD A 014 266  
ACCESS NO: 203,433 February 1975  
TITLE: ACCELERATED CHARACTERIZATION OF FIBER/EPOXY  
COMPOSITES, PART I. VISCOELASTIC METHODS  
AUTHOR(S): A. Thakker, H. Brinson, R. Heller  
CONTRACT NO: F33615-72-C-2111  
CONTRACTOR: Virginia Polytechnic Institute and State University  
PROJECT MONITOR: J. Whitney (AFML/MBM)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: Time dependent properties of angle ply laminated Boron/Epoxy and Graphite/Epoxy fiber controlled composites were investigated. The main objective of this study was to develop a technique to establish interconversion of different test results using appropriate viscoelastic theory to formulate an accelerated testing procedure. To achieve this aim, forced vibration, constant strain rate, and creep tests were performed at different temperature levels.

Multiple regression techniques were used to generate response surfaces for significant variables. Master curves using the time-temperature superposition principle were established for individual tests. Mechanical model representation integral equation formulation and numerical integration methods based on linear viscoelasticity were used to predict constant strain rate and long time creep behavior of composites from nondestructive short time dynamic tests.

REPORT NO: AFML-TR-74-260 AD B 001 862 L  
 ACCESS NO: 203,351 December 1974  
 TITLE: POLYFLUOROALKYL-ALKYL POLYSILOXANE  
 GREASE FOR INSTRUMENT LUBRICATION  
 AUTHOR(S): J. Christian  
 CONTRACT NO: N/A  
 CONTRACTOR: internal  
 PROJECT MONITOR: J. Christian (AFML/MBT)  
 DIST. STATEMENT: U.S. Govt. Agencies Only  
 ABSTRACT: A wide temperature range grease has been developed for instruments required to operate under light to heavy loads and low to moderately high speeds. It is especially suited for use in applications involving rolling, sliding or oscillating motions and where very little wear can be tolerated. The grease is based on a fluorinated ethylenepropylene or polytetrafluoroethylene thickener in a polyfluoroalkyl-alkyl polysiloxane. Its outstanding qualities are its wide temperature range capability, its extreme pressure and anti-wear characteristics, and its non-creep nature.

REPORT NO: AFML-TR-74-278 AD A 015 727  
 ACCESS NO: 203,882 June 1975  
 TITLE: SYNTHESIS OF QUINOZALINE POLYMERS BY  
 INTERMOLECULAR CYCLIZATION  
 AUTHOR(S): Dr. F. Hedberg, Dr. F. Arnold  
 CONTRACT NO: N/A  
 CONTRACTOR: internal  
 PROJECT MONITOR: Dr. F. Arnold (AFML/MBP)  
 DIST. STATEMENT: Approved for public release; distribution unlimited.  
 ABSTRACT: Polyphenylquinoxalines containing 2,2'-bis (phenylethynyl) diphenyl moieties along the polymer backbone have been synthesized. These polymers underwent a novel curing reaction consisting of an intramolecular cyclization to a dibenzoanthracene structure, thereby increasing the rigidity and correspondingly the Tg of the polymers. The significance of this type of reaction as a major breakthrough in the processing of high-processing of high-temperature polymers was shown by the properties obtained for the best system: an initial Tg of 215°C cure at 245°C with no evolution of volatiles; a Tg after cure of 365°C. The initial Tg and cure temperature are compatible with current processing equipment. The nonvolatile intramolecular cure, as has been demonstrated in the phenylquinoxaline polymer system, should provide tough resins for reinforced composites with use temperatures far exceeding processing temperatures.

REPORT NO: AFML-TR-74-279 AD A 016 475  
 ACCESS NO: 203,897 June 1975  
 TITLE: SYNTHESIS OF OXYARYLENE BBB POLYMERS  
 AUTHOR(S): F. Arnold  
 CONTRACT NO: N/A  
 CONTRACTOR: internal  
 PROJECT MONITOR: Dr. F. Arnold (AFML/MBP)  
 DIST. STATEMENT: Approved for public release; distribution unlimited.



**ABSTRACT:** This work was performed to determine the extent to which processability parameters such as solubility and fusibility could synthetically be altered in the benzimidazobenzophenanthroline (BBB) polymer system. The BBB polymer has excellent thermal and thermal oxidative properties; however, the polymer is infusible and is only soluble in highly corrosive solvents. A series of BBB polymers has been synthesized by the reaction of 1,4,5,8 naphthalele-tetra-carboxylic acid anhydride with oxyarylene tetraamines. The resulting BBB type polymers with an increased number of rotational sites along the polymer backbone were soluble in m-cresol and exhibited glass transition temperatures in the 300 - 350°C range. All of the polymers displayed good thermal and thermal oxidative stabilities characteristic of this class of materials.

REPORT NO: AFML-TR-75-11  
 ACCESS NO: 204,008 August 1975  
 TITLE: MOLECULAR TAILORING OF FLUOROCARBON ETHER BIBENZOXAZOLE POLYMERS TO LOWER GLASS TRANSITION TEMPERATURES  
 AUTHOR(S): R. Evers  
 CONTRACT NO: N/A  
 CONTRACTOR: internal  
 PROJECT MONITOR: R. Evers (AFML/MBP)  
 DIST. STATEMENT: U.S. Govt. Agencies Only  
 ABSTRACT: The synthesis of fluorocarbon ether bis (o-aminophenol) monomers was accomplished by a multistep route from long-chain fluorocarbon ether di-iodides and the reaction conditions optimized. Polycyclocondensation of these monomers with novel, long-chain fluorocarbon ether di-imidate esters led to linear fluorocarbon ether bibenzoxazole (FEB) polymers soluble in hexa-fluoroisopropanol and Freon 113. High fluorocarbon ether content gave the desired low glass transition temperatures without significant sacrifices in thermooxidative stabilities. Rubbery polymers with glass transition temperatures as low as -58°C were obtained. With respect to thermooxidative stability, onset of weight loss of the FEB polymers during thermogravimetric analysis in an air atmosphere occurred in the 350° - 400°C range. FEB polymers appear to have great potential as a class of polymers for broad use temperature range elastomer applications which surpass current state-of-the-art materials.

REPORT NO: AFML-TR-75-17  
 ACCESS NO: 204,133 August 1975  
 TITLE: ML-101 THERMAL CONTROL COATING SPACEFLIGHT EXPERIMENT  
 AUTHOR(S): D. Prince  
 CONTRACT NO: N/A  
 CONTRACTOR: internal  
 PROJECT MONITOR: D. Prince (AFML/MBE)  
 PROJECT NO: 7340  
 TASK NO: 734007  
 DIST. STATEMENT: U.S. Govt. Agencies Only  
 ABSTRACT: This report describes a thermal control coatings experiment conducted on the Air Force P72-1 satellite which was launched into a low earth polar orbit in October of 1972. The objectives of this experiment were to measure the amount of degradation of experimental thermal control coatings after exposure to the space environment and to correlate these results with those of space exposure for the same coatings measured in ground-based laboratory simulation equipment. Based on selected data from over 5000 revolutions covering a period of one year, it was found that all the coatings initially degraded to a greater degree than expected, possibly due to contamination. The most stable coatings were

AFML/MB

optical solar reflectors and the least stable was a white  $\alpha$ - $\text{Al}_2\text{O}_3$  pigmented coating. An experimental fabric material showed greater stability than state-of-the-art white coatings.

REPORT NO: AFML-TR-75-19, Part I  
ACCESS NO: 203,846 December 1974  
TITLE: GREASE LUBRICATION OF HELICOPTER TRANSMISSIONS  
AUTHOR(S): B. Simmons  
CONTRACT NO: F33615-72-C-2031  
CONTRACTOR: Sikorsky Aircraft  
PROJECT MONITOR: J. Christian (AFML/MBT)  
PROJECT NO: 7343  
TASK NO: 734301  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: Experimental results are presented for a helicopter transmission high-speed input section operating with grease lubrication. The input section of the main transmission of the S-61 helicopter was operated with a grease lubricant conforming to military specification MIL-G-83363 (USAF). Stabilized operations were not achieved for any significant length of time at speeds higher than 50% of full operating speed. The high-speed ball bearings overheated repeatedly in attempts at high-speed orientation. The testing to date indicates that grease-lubricated operation may not be feasible at the high input speeds of the S-61 main transmission. It is recommended that a hybrid lubrication system utilizing an oil-lubricated high-speed section be evaluated.

REPORT NO: AFML-TR-75-32  
ACCESS NO: 203,570 May 1975  
TITLE: PERFORMANCE OF LUBRICANTS: OILS AND GREASES IN WEAR TESTS AND COMPACT MATERIALS IN BALL BEARINGS  
AUTHOR(S): K. Mecklenburg  
CONTRACT NO: F33615-72-C-1374  
CONTRACTOR: Midwest Research Institute  
PROJECT MONITOR: F. Brooks (AFML/MBT)  
PROJECT NO: 7340, 7343  
TASK NO: 734008, 734301  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: This final report for a 3-year contract contains the results of several projects conducted on the program. The first project was a long-term repeatability study on the four-ball wear testers. The second project was to conduct four-ball wear tests on various oils and greases to determine the ability of the lubricants to prevent wear at various conditions of speed, load, and temperature. The third and fourth projects were to determine performance lives of various greases on the Pop spindles and Navy spindle. The fifth project was grease testing in the Sikorsky rigs. The last project discussed was the long-term testing of lubricant compact materials in ball bearings.

REPORT NO: AFML-TR-75-38, Part I AD B 007 253 L  
ACCESS NO: 203,888 April 1975  
TITLE: INVESTIGATION OF CAGE AND BEARING INSTABILITY IN DESPUN ANTENNA BEARINGS DUE TO CHANGES IN LUBRICANT PROPERTIES  
AUTHOR(S): J. Kannel, S. Bupara, C. Pentlicki

CONTRACT NO: F33615-74-C-5012  
 CONTRACTOR: Battelle Columbus Labs  
 PROJECT MONITOR: Dr. M. Rivera (AFML/MBT)  
 DIST. STATEMENT: U.S. Govt. Agencies Only  
 ABSTRACT: A computer program is being developed for the purpose of investigating cage and bearing instability in a despun antenna bearing. The program utilizes empirical inputs to ensure accuracy of the analytical modeling and comparison with experimental cage-dynamics data are being made to validate the computer predictions. As a result of the experimental and analytical studies conducted thus far, a stability criterion is being postulated. One form of this criterion, denoting the state of stability of the system, can be written as  $D_p = 4C_u^2 / M_e C_s$  where  $C_u$  is related to lubrication parameters,  $M_e$  is the effective cage mass, and  $C_s$  is a cage material-geometry parameter. If  $D_p$  is less than unity, the cage is predicted to be stable. Conversely, if  $D_p$  is greater than unity, an instability should occur.

REPORT NO: AFML-TR-75-48  
 ACCESS NO: 204,005 May 1975  
 TITLE: DEVELOPMENT OF IMPROVED CORE SPLICE ADHESIVES  
 AUTHOR(S): J. Mahoney, E. Crilly  
 CONTRACT NO: F33615-74-C-5026  
 CONTRACTOR: Rockwell International  
 PROJECT MONITOR: T. Aponyi (AFML/MBC)  
 DIST. STATEMENT: U.S. Govt. Agencies Only  
 ABSTRACT: A total of 16 test methods and associated target property values were selected and devised for determining the mechanical, physical, and handling characteristics of a 350°F service core splice adhesive. These were coordinated with knowledgeable people in the industry and subsequently used in the screening and characterization of various formulations. Approximately 90 materials were compounded by the formulator, of which 16 were screened for expansion ratio, slump, peak exotherm, volatile content, and uncured weight per square foot. Three of the most promising adhesives, identified as ADX-814, ADX-814.1, and ADX-815, were subject to all of the remaining tests to characterize them fully. All pertinent test procedures and data are included in this report.

REPORT NO: AFML-TR-75-53 AD B 006 394 L  
 ACCESS NO: 203,812 July 1975  
 TITLE: CORROSION BEHAVIOR OF METAL FASTENERS IN GRAPHITE-EPOXY COMPOSITES  
 AUTHOR(S): D. Prince  
 CONTRACT NO: N/A  
 CONTRACTOR: internal  
 PROJECT MONITOR: D. Prince (AFML/MBE)  
 PROJECT NO: 7340  
 TASK NO: 734007  
 DIST. STATEMENT: U.S. Govt. Agencies Only  
 ABSTRACT: The corrosion characteristics of metal fasteners in intimate contact with graphite-epoxy composites were studied and compared with their corrosion in aluminum. Results showed that unprotected aluminum, cadmium plated steel, and corrosion resistant steel (A286) fasteners corroded much more rapidly in graphite-epoxy composites than in aluminum. The presence of protective organic coatings slowed corrosion, but when the coatings were flawed, significant galvanic corrosion occurred. Titanium-6Al-4V and Multiphase (AMS 5758) fasteners showed no visible evidence of corrosion when in contact with graphite-epoxy composites even after 500 hours of salt spray exposure.



AFML/MB

REPORT NO: AFML-TR-75-59 AD B 006 648 L  
ACCESS NO: 203,793 May 1975  
TITLE: HIGH TEMPERATURE STABLE SUBSONIC RAIN EROSION  
RESISTANT FLUOROELASTOMER COATINGS DEVELOPMENT.  
AUTHOR(S): J. Moraveck, H. Barnowski  
CONTRACT NO: F33615-71-C-1468  
CONTRACTOR: Olin Corporation  
PROJECT MONITOR: G. Schmitt (AFML/MBE)  
PROJECT NO: 7340  
TASK NO: 734007  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: Evaluation of property data and rotating arm test results as a function of reactive oxide, pigment, and curing agent concentration resulted in the selection of a particular black fluoroelastomer formulation as a candidate rain erosion resistant, high temperature resistant coating. Development of a white fluoroelastomer formulation based on a modified procedure for introducing cross-link sites into the polymer facilitated the development of a white coating system with subsonic erosion resistance equal to MIL-C-83231 coatings. The room temperature curable fluoroelastomer coating withstands a thermal flash pulse in excess of 60 cal/cm<sup>2</sup> total fluence. Rotating arm test results confirm the excellent retention of erosion resistance after Florida weathering and accelerated conditionings. The recommended white fluoroelastomer coating is undergoing flight testing on an RF-4C Radome at Hill A.F.B., Utah.

REPORT NO: AFML-TR-75-61 AD B 006 264 L  
ACCESS NO: 203,794 May 1975  
TITLE: INFRARED TRANSPARENT POLYMERIC FILMS  
AUTHOR(S): N. Bilow, et al.  
CONTRACT NO: F33615-74-C-5051  
CONTRACTOR: Hughes Aircraft Co.  
PROJECT MONITOR: J. Weaver (AFML/MBE)  
PROJECT NO: 7340  
TASK NO: 734007  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: Research was conducted on fluorocarbon polymers, fluoroalkylated polyphosphazenes, and fluoroalkylated silicones in an attempt to produce infrared transparent polymers (to 6μ) suitable for use as binders in highly reflective aircraft coatings. The investigation was limited to the modification of commercially available polymers. Ambient temperature cures were sought and chemical structure modifications which had the potential of improving flow characteristics, gloss, and hardness were made. The most successful paint formulation was produced by the copolymerization of tetra fluoroethylene-vinylidene fluoride copolymer and hexafluoropropylene-vinylidene fluoride copolymer, and pigmented with barium titanate. The optical and physical properties were determined.

REPORT NO: AFML-TR-75-64 AD B 008 197 L  
ACCESS NO: 204,134 October 1975  
TITLE: THERMAL RESPONSE OF WOVEN AND KNITTED FABRICS  
IN JP-4 FUEL FIRE ENVIRONMENT  
AUTHOR(S): R. Stanton, S. Schulman  
CONTRACT NO: N/A  
CONTRACTOR: internal  
PROJECT MONITOR: J. Ross, S. Schulman (AFML/MBE)  
PROJECT NO: 7320  
TASK NO: 732002  
DIST. STATEMENT: U.S. Govt. Agencies Only

AFML/MB

**ABSTRACT:** The heat flow process from a fire, through a clothing (fabric) system to the underlying skin was investigated both analytically and empirically. The program goal was to optimize the fiber and fabric to provide the maximum thermal protection. Both laboratory and full-scale JP-4 fuel fires were used to demonstrate the degree of correlation with data generated using analytical methods/computer code. Based on this investigation and the related flammability data obtained in laboratory and full-scale fuel fires it can be concluded that: 1) Fiber thermal stability is the most important parameter in designing thermally protective fabrics. Only two fibers, stabilized PBI and HT-4, can meet this most critical parameter. 2) Fabric weight, thickness, and optical properties are important parameters which can be adjusted by fabric design and chemical additives to yield improved protective properties. 3) Full scale fuel fire exposures have confirmed analytical and laboratory data that both stabilized PBI and HT-4 provide significantly more protection than Nomex in lightweight (4.5±0.2 ounces/square yard) fabric garments.

**REPORT NO:** AFML-TR-75-69  
**ACCESS NO:** 204,038 **March 1975**  
**TITLE:** DEVELOPMENT OF CORROSION RESISTANT SURFACE  
TREATMENTS FOR ALUMINUM ALLOYS FOR SPOT-WELD BONDING  
**AUTHOR(S):** B. Bowen, R. Herfert, K. Wu  
**CONTRACT NO:** F33615-74-C-5027  
**CONTRACTOR:** Northrop Corp.  
**PROJECT MONITOR:** T. Aponyi (AFML/MB)  
**PROJECT NO:** 7340  
**TASK NO:** 734002  
**DIST. STATEMENT:** U.S. Govt. Agencies Only  
**ABSTRACT:** The objective of this program was to develop a corrosion resistant spot-weld bonding system for aluminum aircraft primary structures. Anodizing and chemical surface treatment were investigated. Chemical and microscopic techniques indicated that the most suitable corrosion resistant surface on aluminum should be a boehmite surface,  $\gamma\text{-Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$ . A treatment consisting of the standard FPL etch followed by 90-minute sealing in boiling sodium dichromate solution gave a weldable surface with good corrosion resistance. Adhesives were investigated for use in the spot-welding process and a modified B.F. Goodrich A-1396B adhesive was found to be best. The selected spot-weld bonding system is FPL etch with a 90-minute dichromate seal and the modified A-1396B adhesive.

**REPORT NO:** AFML-TR-75-70, Part I  
**ACCESS NO:** 203,826 **May 1975**  
**TITLE:** ADVANCED PROTECTIVE MATERIALS FOR REENTRY  
MISSILE NOSETIPS, PART I: THREE-DIMENSIONAL  
REINFORCED CARBON/PLASTIC COMPOSITES  
**AUTHOR(S):** R. Popp  
**CONTRACT NO:** F33615-74-C-5048  
**CONTRACTOR:** McDonnell Douglas Astronautics Co. - East  
**PROJECT MONITOR:** R. Craig (AFML/MB)  
**DIST. STATEMENT:** U.S. Govt. Agencies Only

AFML/MB

ABSTRACT: Advanced thermal protection materials are required for missile reentry systems to assure survival in natural and hostile environments. The most critical requirement is for shape stable nosetip materials. One promising nosetip design involves the use of a low recession apex plug with a trailing insulative plastic skirt. Silica or carbon fabric reinforced phenolics are typically used for the skirt region because of their excellent insulative properties, low ablative recession, low cost, and available fabrication techniques. These two-dimensional composites have limited potential for more demanding applications because of their low mechanical properties and interlaminar shear strength, erosion by hypervelocity particles, and degradative effects of nuclear weapons. Multidirectional carbon fiber reinforced resinous composites offer outstanding potential for alleviating these materials limitations, and for that reason, an investigation of these unique composites was performed.

REPORT NO: AFML-TR-75-71 AD B 006 836 L  
ACCESS NO: 203,843 June 1975  
TITLE: SHOCK LAYER SHATTERING OF WATER DROPS AND  
ICE CRYSTALS IN REENTRY  
AUTHOR(S): W. Reinecke, G. Waldman, et al.  
CONTRACT NO: F33615-74-C-5143  
CONTRACTOR: Avco Systems Division  
PROJECT MONITOR: G. Schmitt (AFML/MBE)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: A study has been conducted to determine the amount of protection against erosion that will be provided by the shock layer to a reentry vehicle traversing a cloud of water drops or ice crystals. The methods of applying the data and correlations to flight is detailed and representative calculations of flight cases are given to illustrate the practical importance of drop breakup. The erosion protection is shown to be significant. Ballistic range tests were conducted to verify that the breakup criterion developed in the shock tube tests does indeed correspond to the condition in flight at which the drops no longer damage the vehicle surface.

REPORT NO: AFML-TR-75-72 AD A 016 525  
ACCESS NO: 203,891 July 1975  
TITLE: EXPLORATORY DEVELOPMENT OF COATED FABRIC  
FOR FIREFIGHTERS' PROTECTIVE CLOTHING  
AUTHOR(S): N. Abbott, T. Lannefeld, R. Erlandson  
CONTRACT NO: F33615-74-C-5117  
CONTRACTOR: Fabric Research Labs  
PROJECT MONITOR: S. Schulman (AFML/MBC)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: The objective of the work was to improve the durability of the aluminized fabric currently used for the outer layer of firefighters' proximity coats. Two possible improvements were developed: (a) Substituting a Viton/bronze coating for the aluminum, and adding a topcoat of pigmented urethane to improve wear resistance. Sample lengths of both types of coated fabric were produced.

REPORT NO: AFML-TR-75-77  
ACCESS NO: 203,823 March 1975  
TITLE: SKYLAB DO24 THERMAL CONTROL COATINGS AND  
POLYMERIC FILMS EXPERIMENT  
AUTHOR(S): W. Lehn, C. Hurley



AFML/MB

CONTRACT NO: N/A  
CONTRACTOR: internal  
PROJECT MONITOR: W. Lehn (AFML/MBE)  
PROJECT NO: 7340  
TASK NO: 734007  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: Preliminary results of an experiment designed to determine the effects of the external Skylab space environment on the performance and properties of a wide variety of selected thermal control coatings and polymeric films are presented. Post flight analysis of the three sets of recovered thermal control coatings indicated that measured changes in specimen thermooptical properties are due to a combination of excessive contamination and solar degradation of the contaminant layer. Preliminary experimental results on the analysis of the contamination are also presented.

REPORT NO: AFML-TR-75-85, Part I  
ACCESS NO: 203,982  
TITLE: SYNTHESIS OF THERMALLY STABLE POLYMERS  
AUTHOR(S): C. Marvel  
CONTRACT NO: F33615-74-C-5113  
CONTRACTOR: University of Arizona  
PROJECT MONITOR: G. Loughran (AFML/MBP)  
PROJECT NO: 7340  
TASK NO: 734004  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: Some aromatic polyethers, -sulfones and -ketone polymers containing units from 2,5-dicyanoterephthalic acid have been made. The extra cyano groups improve the crosslinking in these polymers. Attempts to synthesize some cyano polymers with the cyano group separated from the main chain have not been successful. Further work on the use of paracyclophane units in the backbone chain of aromatic polyethers, -sulfones and -ketone polymers has been carried out.

AD B 007 692 L  
August 1975

REPORT NO: AFML-TR-75-83  
ACCESS NO: 204,108  
TITLE: AEROSPACE MATERIALS RESPONSE TO INTENSE THERMAL RADIATION  
AUTHOR(S): F. Vondersaar  
CONTRACT NO: N/A  
CONTRACTOR: internal  
PROJECT MONITOR: R. Craig (AFML/MBC)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: A survey of methods of testing the response of materials to intense thermal radiation is given. Particular emphasis is given to simulation of the thermal flash from a nuclear weapon with a Quartz Lamp Bank. Results of several tests are shown.

AD A 019 453  
September 1975

REPORT NO: AFML-TR-75-86  
ACCESS NO: 203,883  
TITLE: NEW ELASTOMERIC POLYMERS AND SPECIALTY CHEMICALS  
AUTHOR(S): K. Baucom  
CONTRACT NO: F33615-74-C-5032  
CONTRACTOR: PCR, Inc.  
PROJECT MONITOR: Capt. R. Cochey (AFML/MBE)

AD B 006 859 L  
June 1975

AFML/MB

PROJECT NO: 7340  
TASK NO: 734005  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: Monomers such as perfluorinated alkylene and alkylene oxide mono- and diacetylenes, dinitriles, and vinyl ethers have been prepared and sent to the Air Force Materials Laboratory or its contractors. Polymers of vinylidene fluoride with various perfluorinated vinyl ethers have been prepared and sent to the Air Force Materials Laboratory.

REPORT NO: AFML-TR-75-90  
ACCESS NO: 204,032  
TITLE: DEVELOPMENT OF HIGH TEMPERATURE ADDITION-CURED ADHESIVES  
AUTHOR(S): R. Boschan, A. Landis  
CONTRACT NO: F33615-73-C-5062  
CONTRACTOR: Hughes Aircraft Co.  
PROJECT MONITOR: T. Aponyi (AFML/MBC)  
PROJECT NO: 7340  
TASK NO: 734002  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: Several modifications of the previously studied HR 600 adhesive were chosen for investigation as addition-cured polyimide adhesives for titanium. All of the materials studied were acetylene terminated oligomers which were prepared by reacting an arylenediamine with benzophenonetetracarboxylic dianhydride (BTDA) and capping this product with either 3-aminophenylacetylene (I) or 3-(3-aminophenoxy) phenylacetylene (II), followed by imidizing in a refluxing benzene-cresol mixture or in acetic anhydride. The most promising oligomers from the standpoint of melting point, solubility, flow properties and adhesive strength were those from I, BTDA, and 1,3-di (aminophenoxy) benzene (III), designated HR 600 DP-2 (HR 600 oligomer), and from II, BTDA, and III, designated HR 650. Elevated temperature air aging tests (90 percent RH at 160°F) are very encouraging.

REPORT NO: AFML-TR-75-98  
ACCESS NO: 204,039  
TITLE: DEVELOPMENT OF POLYESTER/WOOL UNIFORM FABRIC WITH IMPROVED DURABILITY AND APPEARANCE  
AUTHOR(S): W. Carter, S. Henson  
CONTRACT NO: F33615-72-C-1822  
CONTRACTOR: Georgia Institute of Technology  
PROJECT MONITOR: D. May (AFML/MBC)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: The mechanism of "frosting" of polyester/wool uniform fabrics has been established. An exploratory research and development program has been carried out to establish those factors in the composition, construction, and processing of polyester/wool uniform fabrics which contribute to their wearing characteristics, particularly their pilling and frosting behavior. Based on findings, six specification fabrics exhibiting improved wear performance have been prepared for a service test program.

AFML/MB

REPORT NO: AFML-TR-75-103 AD B 007 429 L  
ACCESS NO: 203,901 July 1975  
TITLE: SYNTHESIS OF PERFLUOROALIPHATIC ETHER MONOMERS  
AUTHOR(S): T. Psarras  
CONTRACT NO: F33615-73-C-5042  
CONTRACTOR: PCR, Inc.  
PROJECT MONITOR: R. Evers (AFML/MBP)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: Perfluoroacyl nitriles were obtained by reaction of HFPR-oligomer acyl chlorides with silver cyanide. With primary perfluoroacyl chlorides the originally formed acyl nitrile reacts further with AgCN and RfCOCl to form  $\alpha$ ,  $\omega$ -dicyanoperfluoroesters as the major product. Primary perfluoroether acyl fluorides were obtained by thermal rearrangement of perfluorovinyl ethers at 230°C. Primary perfluoroether iodides are obtained by reaction of perfluorovinyl ethers and iodine at 230°C. The preparation of a variety of perfluoroether iodides is reported.

REPORT NO: AFML-TR-75-122 AD A 018 636  
ACCESS NO: 204,107 October 1975  
TITLE: SURFACE ANALYSIS OF 2024 AND 7075 ALUMINUM ALLOYS AFTER CONDITIONING BY CHEMICAL TREATMENTS  
AUTHOR(S): N. McDevitt, W. Baun, J. Solomon  
CONTRACT NO: N/A  
CONTRACTOR: internal  
PROJECT MONITOR: N. McDevitt (AFML/MBM)  
PROJECT NO: 7340  
TASK NO: 73400216  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: This investigation was carried out to determine the effect of various chemical treatments on the surface of 2024-T3 and 7075-T6 bare aluminum alloys. After treatment various chemical elements can be found on the surface arising from the alloy constituents, the chemical solution or tap water rinse. The chemical signature of each surface should be known to assess adhesive bond durability.

REPORT NO: AFML-TR-75-128 AD B 003 937 L  
ACCESS NO: 204,106 August 1975  
TITLE: PPQ ADHESIVES FOR LARGE AREA BONDING OF TITANIUM ALLOYS  
AUTHOR(S): M. O'Rell, C. Sheppard, R. Vaughan, R. Jones  
CONTRACT NO: F33615-74-C-5017  
CONTRACTOR: TRW Systems  
PROJECT MONITOR: L. Picklesimer (AFML/MBC)  
PROJECT NO: 7340  
TASK NO: 734003  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: A Diels-Alder reaction was investigated as a means to crosslink polyphenylquinoxalines (PPQ) which were intended for use as adhesives in large area bonding of titanium alloys. Two promising candidate polymers were identified for process development studies. Double lap-shear specimens were press cure fabricated from the adhesives and Ti-6Al-4V adherends which demonstrated room temperature strengths of 4000 psi and elevated temperature strengths of 2800 psi and 2000 psi at 450°F and 550°F, respectively. Detailed evaluation studies were conducted which included stress durability determinations, crack extension



AFML/MB

measurements, peel strength measurements, and blister detection tests which demonstrated applicability for preparing large area bonded specimens. The results of the detailed testing indicated that the crosslinked PPQ adhesive possessed toughness and that large area bonded specimens can be press-cure fabricated.

REPORT NO: AFML-TR-75-146 AD B 008 267 L  
ACCESS NO: 204,095 September 1975  
TITLE: NON-SPECULAR COATINGS  
AUTHOR(S): R. Peterson, P. Zimmer  
CONTRACT NO: F33615-74-C-5070  
CONTRACTOR: Honeywell, Inc.  
PROJECT MONITOR: J. Weaver (AFML/MBE)  
PROJECT NO: 7340  
TASK NO: 734007  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: The main objective of this program was to develop aircraft coatings having low diffuse reflectance and low specular reflectance in the infrared (0.7 to 5.0  $\mu\text{m}$ ) and color tailorability in the visible (0.4 to 0.7  $\mu\text{m}$ ). Such coatings were to be developed without sacrificing the normal serviceability expected of coating systems for USAF aircraft. A second objective was to design and fabricate a portable instrument so that it could be used both in the laboratory and in the field to characterize the bidirectional reflectance of paint coatings. Three coating systems, a light grey polyurethane, an olive drab polyurethane, and an olive drab acrylic were investigated in detail. Flatting agents were used to improve gloss, durability, and handling characteristics. Comparative tests with commercially available low gloss paints demonstrated the feasibility of significant improvements with the newly developed coatings.

REPORT NO: AFML-TR-75-155 AD B 008 705 L  
ACCESS NO: 204,103 September 1975  
TITLE: ON THE SHAPE OF ERODING BODIES WITH APPLICATION TO BALLISTIC RANGE EROSION TESTS  
AUTHOR(S): H. Buss, W. Reinicke, N. Thyson  
CONTRACT NO: F33615-74-C-5149  
CONTRACTOR: Avco Systems Division  
PROJECT MONITOR: G. Schmitt (AFML/MBE)  
PROJECT NO: 7340  
TASK NO: 734007  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: The problem of the time dependent shape change bodies undergoing high speed erosion is formulated in general, and solutions given for initially spherical and parabolic bodies. The results are employed to calculate the ratio of the average mass loss ratio measured shadowgraphically in ballistic range erosion tests to the normal impact mass loss ratio.

REPORT NO: AFML-TR-75-165  
ACCESS NO: 203,900 August 1975  
TITLE: RESULTS OF THE POLYMERIC FILMS SKYLAB D024 EXPERIMENT  
AUTHOR(S): W. Lehn, C. Hurley  
CONTRACT NO: N/A  
CONTRACTOR: internal

PROJECT MONITOR: W. Lehn (AFML/MBE)  
PROJECT NO: 7340  
TASK NO: 734007  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: Results of an experiment designed to evaluate the effects of the near earth environment on the performances and properties of selected polymeric films were exposed to the Skylab space environment for varying periods of time during the mission. The individual specimen holders were retrieved during EVA by the Astronauts, placed in hermetically sealed containers, recovered, and returned to the Air Force Materials Laboratory for analysis and evaluation. Post-flight analysis of the three sets of recovered polymeric films indicated measured changes in the optical, physical, and electrical properties were due to a combination of excessive contamination, solar degradation of the polymer film materials. The degree of contamination experienced compromises the measurement of the degradation of the polymeric film themselves. Experimental results on the analysis of contamination are also presented.

SYSTEMS SUPPORT DIVISION (AFML/MX)

REPORT NO: AFML-TR-74-39, Supplement II AD B 008 163 L  
 ACCESS NO: 204,048 August 1975  
 TITLE: THE CARBON/CARBON ASSESSMENT PROGRAM 50 MW  
 ABLATION TESTING AND RESULTS  
 AUTHOR(S): R. Maurer, C. Powars  
 CONTRACT NO: F33615-71-C-1215  
 CONTRACTOR: Aerotherm Division  
 PROJECT MONITOR: Capt. E. Ross (AFML/MXS)  
 DIST. STATEMENT: U.S. Govt. Agencies Only  
 ABSTRACT: Steady state recession and shape change histories were observed for the Carbon/Carbon Assessment Program materials at 4 different conditions in the AFFDL 50 MW RENT facility. In general, the materials performed similarly with the PF 3D material maintaining laminar flow conditions better than the other carbon/carbon composites used.

REPORT NO: AFML-TR-74-207 AD B 002 538 L  
 ACCESS NO: 203,389 September 1974  
 TITLE: IMPROVED INSULATOR MATERIALS REQUIREMENT PROGRAM  
 AUTHOR(S): R. Gillian, S. Dunn  
 CONTRACT NO: F33615-73-C-5142  
 CONTRACTOR: Prototype Development Associates, Inc.  
 PROJECT MONITOR: C. Pratt, Jr. (AFML/MXS)  
 DIST. STATEMENT: U.S. Govt. Agencies Only  
 ABSTRACT: The objective of this program was to determine the materials requirements for improved insulators for carbon/carbon reentry vehicles. Systems tradeoff studies were conducted to determine significant material parameters, and an evaluation of all viable insulator candidates was made. Test data requirements are recommended for acceptance testing and for developing an engineering design data base. Recommendations for potential materials improvements are made.

REPORT NO: AFML-TR-74-229 AD B 002 936 L  
 ACCESS NO: 203,438 September 1974  
 TITLE: ANALYSIS OF HIGH STRAIN GRAPHITE  
 AUTHOR(S): J. Stanwood  
 CONTRACT NO: F33615-74-C-5061  
 CONTRACTOR: Philco-Ford Corp.  
 PROJECT MONITOR: Lt. G. Hollenberg (AFML/MXS)  
 DIST. STATEMENT: U.S. Govt. Agencies Only  
 ABSTRACT: A systematic study of thermostructural response of material properties and property variations representative of high strain graphitic materials is accomplished. An optimum combination of properties is selected. Nosetip geometries are identified which provide substantial performance advantage over AFJS graphite in the severe reentry erosion environment.

REPORT NO: AFML-TR-74-232 AD B 006 439 L  
 ACCESS NO: 203,623 June 1975  
 TITLE: THERMOSTRUCTURAL RESPONSE OF CARBON/CARBON  
 MATERIALS UNDER HIGH HEAT FLUX ENVIRONMENTS



AUTHOR(S): H. Starrett, F. Weiler, C. Pears  
 CONTRACT NO: F33615-71-C-1566  
 CONTRACTOR: Southern Research Institute  
 PROJECT MONITOR: Capt. C. Budde (AFML/MXS)  
 DIST. STATEMENT: U.S. Govt. Agencies Only  
 ABSTRACT: The objective of this program was to develop a continuum material model which could be used to predict the response of carbon/carbon materials under thermostructural loadings. The experimental material was the MOD 3a carbon/carbon. A deformation model was developed which is controlled primarily by an inplane shear response of the material. This model predicts the off-axis tensile and compressive responses that were measured in laboratory tests. The model was used in a finite element computer code to predict the thermostructural response of MOD 3a in the SORI temperature/stress test in specimens with both xy and xz orientations. The prediction of yield or degradation zones agree qualitatively with the experimental observations.

REPORT NO: AFML-TR-74-254 AD B 002 921 L  
 ACCESS NO: 203,415 January 1975  
 TITLE: THE DEVELOPMENT AND DEMONSTRATION OF A  
 HIGH TEMPERATURE RING TEST FACILITY  
 AUTHOR(S): A. Bush, J. Legg, C. Pears  
 CONTRACT NO: F33615-73-C-5118  
 CONTRACTOR: Southern Research Institute  
 PROJECT MONITOR: Capt. E. Ross (AFML/MXS)  
 DIST. STATEMENT: U.S. Govt. Agencies Only  
 ABSTRACT: The objective of the program was to provide the engineering effort required to develop and demonstrate a high temperature capability for a "hydrostatic" ring test. A need for this capability exists in characterizing the elevated temperature hoop tensile properties of carbon/carbon heatshield materials. The program resulted in the development of a test facility for hoop tensile ring evaluations at elevated temperatures. Tests were successfully run up to a temperature of 2000 F.

REPORT NO: AFML-TR-74-259 AD A 010 425  
 ACCESS NO: 203,565 February 1975  
 TITLE: NONLINEAR DEFORMATION OF GRAPHITIC MATERIALS  
 AUTHOR(S): R. Jones, D. Nelson, Jr.  
 CONTRACT NO: F33615-73-C-5124  
 CONTRACTOR: Southern Methodist University  
 PROJECT MONITOR: Capt. C. Budde, Capt. J. Koenig (AFML/MXS)  
 DIST. STATEMENT: Approved for public release; distribution unlimited.  
 ABSTRACT: Artificial graphites have been used for the past decade in reentry vehicle nosetips. Severe design requirements are imposed on nosetips because of their operational environment. Thus, accurate stress analysis procedures are of paramount importance. A new model for the deformation behavior of this group of nonlinear transversely isotropic materials under initial loading is described. This material model, which is based on a new deformation theory of orthotropic plasticity, has excellent potential for description of the unusual phenomenon of "biaxial (multiaxial) softening" found in ATJ-S graphite.

REPORT NO: AFML-TR-74-262 AD A 013 166  
 ACCESS NO: 203,720 March 1975  
 TITLE: BIAxIAL TENSILE FRACTURE OF ATJ-S GRAPHITE

AUTHOR(S): J. Jortner  
 CONTRACT NO: F33615-74-C-5081  
 CONTRACTOR: McDonnell Douglas Astronautics Co.  
 PROJECT MONITOR: Capt. C. Budde, Capt. G. Hollenberg (AFML/MXS)  
 DIST. STATEMENT: Approved for public release; distribution unlimited.  
 ABSTRACT: Failure strains were measured in specimens of ATJ-S graphite fractured in biaxial tension using a test method that relies on the centrifugal forces produced by rotation to induce the desired stresses. It is shown that, at a given level of strain, the fracture probability is somewhat larger in biaxial tension than in uniaxial tension. An exploratory biaxial test on a specimen of carbon/carbon composite was conducted in the same test fixtures to demonstrate the wider applicability of the rotational method. Stress calculations using elastic and two nonlinear constitutive formulations, are presented for rotating bodies in the form of circular disks and slender bars. The validity of the various assumed stress-strain laws is discussed briefly. The possibility of designing a rotating device capable of testing cylindrical specimens in triaxial tension is discussed.

REPORT NO: AFML-TR-74-266 AD A 014 363  
 ACCESS NO: 203,772 February 1975  
 TITLE: DEVELOPMENT OF ENGINEERING DATA ON THE  
 MECHANICAL AND PHYSICAL PROPERTIES OF ADVANCED  
 COMPOSITE MATERIALS

AUTHOR(S): K. Hofer, D. Larsen, V. Humphreys  
 CONTRACT NO: F33615-73-C-5125  
 CONTRACTOR: Illinois Institute of Technology Research Institute  
 PROJECT MONITOR: M. Knight (AFML/MXE)  
 PROJECT NO: 7381  
 TASK NO: 738106  
 DIST. STATEMENT: Approved for public release; distribution unlimited.  
 ABSTRACT: Data were generated on the effect of various environments on the physical, thermal, and mechanical properties of Thornel 300/Narmco 5208 composites. The environments included steady state humidity conditioning for two exposure periods, cyclic humidity conditioning which included the effects of thermal shocks and the effect of photo-degradative exposures, and steady and cyclic thermal exposures. The mechanical properties investigated included tension, compression, in-plane shear, interlaminar shear and flexural static properties, fatigue, creep and stress-rupture resistances. Overall the Thornel 300/Narmco 5208 composite system showed consistent strengths and moduli, over the range of temperatures studied (room temperature to 350°F) and after a wide variety of humidity and thermal conditioning treatments. The system possesses a high resistance to degradation of its mechanical properties after exposure to humidity and thermal conditioning.

REPORT NO: AFML-TR-74-271 AD B 001 615 L  
 ACCESS NO: 203,341 February 1975  
 TITLE: ELASTIC COMPLIANCES FOR ATJ-S GRAPHITE AND  
 MOD 3a CARBON/CARBON  
 AUTHOR(S): H. Starrett, C. Pears  
 CONTRACT NO: F33615-72-C-1591  
 CONTRACTOR: Southern Research Institute  
 PROJECT MONITOR: Capt. E. Ross, C. Pratt (AFML/MXS)  
 DIST. STATEMENT: U.S. Govt. Agencies Only

AFML/MX

ABSTRACT: Lateral strain measurements were made on larger than normal specimens of ATJ-S graphite and MOD 3a carbon/carbon to determine whether or not the values of Poisson's Ratio given in the ATJ-S (WS) data book (AFML-TR-73-14) were reasonable over the temperature ranges of interest and to provide some Poisson's Ratio values for MOD 3a which can be used in preliminary design work.

REPORT NO: AFML-TR-75-3 AD A 008 529  
ACCESS NO: 203,456 February 1975  
TITLE: DURABILITY OF ADHESIVE BONDED JOINTS  
AUTHOR(S): A. Marceau, W. Scardino  
CONTRACT NO: F33615-74-C-5065  
CONTRACTOR: Boeing  
PROJECT MONITOR: W. Scardino (AFML/MXE)  
PROJECT NO: 7381  
TASK NO: 738106  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: This technical report is a complete survey of test methods in use or proposed by various investigators for determining the durability, under stress and adverse environments, of adhesive bonded joints and structures. Illustrations of the methods are given along with a discussion and analysis of each method. References for all methods are tabulated and a summary table is presented giving evaluation criteria and advantages and disadvantages of the various tests.

REPORT NO: AFML-TR-75-7  
ACCESS NO: 203,801 April 1975  
TITLE: EXPLORATORY DEVELOPMENT OF WELD QUALITY DEFINITION  
AUTHOR(S): R. Witt, O. Paul  
CONTRACT NO: F33615-72-C-2039  
CONTRACTOR: Grumman Aerospace Corp.  
PROJECT MONITOR: P. Hendricks (AFML/MXA)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: The purpose of this program was to conduct an exploratory evaluation of the effects of typical weld anomalies on fatigue endurance of Ti-6Al-4V titanium alloy weldments and to propose criteria for acceptance/rejection of titanium fusion welds. The program objectives were as follows: 1) to determine the feasibility of producing typical defects in Ti-6Al-4V titanium alloy weldments by intentional variation of processing parameters, utilizing Ti-6Al-4V (STOA) plates as base materials; 2) to evaluate the effect of flaws produced intentionally in experimental welds by electron-beam (EB), plasma-arc (PA), gas-tungsten-arc (GTA), and gas-metal-arc (GMA) welding on fatigue endurance; and 3) to propose acceptance criteria for titanium fusion weldments based on correlation of fatigue test results with both nondestructive inspection and fractographic findings.

REPORT NO: AFML-TR-75-14 AD A 013 879  
ACCESS NO: 203,773 June 1975  
TITLE: STRESSES IN AN ADHESIVE BONDED COMPOSITE-TO-METAL ASSEMBLY  
AUTHOR(S): T. Reinhart, W. Scardino  
CONTRACT NO: N/A  
CONTRACTOR: internal  
PROJECT MONITOR: W. Scardino (AFML/MXE)



DIST. STATEMENT: Approved for public release; distribution unlimited.  
 ABSTRACT: An in-house program was initiated in order to demonstrate the engineering feasibility of the use of boron/epoxy composites to add stiffness to metallic structural components. The program was designed to determine the level of the stresses induced in the boron/epoxy (B/E) composite, 321 stainless steel substrate, and in the structural adhesive joining the two adherends. Limitations in the equipment available, amount of boron prepreg on hand, and in the available NDI equipment dictated the final size and geometry of the specimen. Essentially, the specimen selected was designed to induce severe thermal mismatch stresses in the composite and in the adhesive, and was intended to be a "worst case" test specimen. After thermal cycles and 134 days humidity exposure we had been unable to detect any debonds or flaws in the assembly. C-scan and acoustic emission were utilized to monitor the component periodically throughout the exposure testing.

REPORT NO: AFML-TR-75-20 AD A 014 353  
 ACCESS NO: 203,783 April 1975  
 TITLE: STATIC AND DYNAMIC FRACTURE PROPERTIES FOR ALUMINUM

ALLOY 7475-T651 AND T7351

AUTHOR(S): R. Cervay  
 CONTRACT NO: F33615-74-C-5024  
 CONTRACTOR: University of Dayton  
 PROJECT MONITOR: D. Watson (AFML/MXE)

DIST. STATEMENT: Approved for public release; distribution unlimited.

ABSTRACT: A broad base of mechanical property data were developed on two plates of Al 7475. One of the 1½-inch thick plates was in the T7351 condition and one was in the T651 condition. The conditional toughness values ( $K_Q$ ) for identical test conditions indicate the T7351 processing possesses the superior toughness property. The smooth and notched fatigue properties were about equal to those of other 7000-series aluminum alloys. Constant amplitude fatigue crack growth resistance was better than some older 7000-series alloys and similar to other new 7000-series alloys while the stress corrosion cracking properties in a salt water environment were excellent. Most of the tests were repeated using specimens that had been subjected to 250°F (121°C) for 1000 hours. This time-temperature exposure resulted in: (1) a slight reduction in tensile strength, (2) a slight increase in conditional toughness ( $K_Q$ ) for the T651 plate and a small decrease in  $K_Q$  for the T7351 heat treated plate, (3) a slight reduction in fatigue properties, and (4) negligible effect on the fatigue crack growth rate and corrosion properties.

REPORT NO: AFML-TR-75-25, Vol. I  
 ACCESS NO: 203,847 April 1975  
 TITLE: EXPLORATORY DEVELOPMENT OF HYPERSONIC HEAT

TRANSFER AND THERMOCHEMICAL ABLATION OF ADVANCED  
 MATERIALS: NOSETIP TEST DATA EVALUATION AND ROUGH  
 WALL TRANSITION

AUTHOR(S): K. Chen, V. DiChristina, T. Lin, T. Liu  
 CONTRACT NO: F33615-72-C-1803  
 CONTRACTOR: Avco Government Products Group  
 PROJECT MONITOR: Capt. G. Jumper (AFML/MXS)  
 DIST. STATEMENT: U.S. Govt. Agencies Only

ABSTRACT: The overall program study was in three specific areas: (1) evaluation of wind tunnel test data, (2) roughwall boundary layer transition, and (3) review of European turbulent boundary layer state-of-the-art. The first two topics are included in Volume I and the last topic comprises Volume II.

AFML/MX

REPORT NO: AFML-TR-75-25, Vol. II  
ACCESS NO: 203,847  
TITLE: EXPLORATORY DEVELOPMENT OF HYPERSONIC  
HEAT TRANSFER AND THERMOMECHANICAL  
ABLATION OF ADVANCED MATERIALS  
AUTHOR(S): T. K. Fannelop  
CONTRACT NO: F33615-72-C-1803  
CONTRACTOR: Avco Systems Division  
PROJECT MONITOR: Capt. G. Jumper (AFML/MXS)  
PROJECT NO: 7381  
TASK NO: 73810264  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: The overall program study was in three specific areas:  
(1) evaluation of wind tunnel test data, (2) rough wall boundary layer transition,  
and (3) review of European turbulent boundary layer prediction methods. In parti-  
cular, work related to nosetip boundary layer phenomenology, including the effects  
of roughness, body curvature, preparation, and reattachment are discussed.

AD A 016 783  
April 1975

REPORT NO: AFML-TR-75-37, Vol. I, II, III  
ACCESS NO: 204,136  
TITLE: DOASIS: A COMPUTER CODE FOR THE  
DEFORMATION PLASTIC, ORTHOTROPIC,  
AXISYMMETRIC, (AND PLANE) SOLUTION  
OF INELASTIC SOLIDS  
AUTHOR(S): F. Weiler  
CONTRACT NO: F33615-74-C-0148  
CONTRACTOR: Weiler Research, Inc.  
PROJECT MONITOR: Capt. C. Budde (AFML/MXS)  
PROJECT NO: 63311F  
TASK NO: 627A0013  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: Volume I (Finite Element Program) involves the finite element  
(displacement) method in determining the displacements, (elastic, plastic, thermal)  
strains and stresses, as well as effective strains and stresses in axisymmetric,  
constant thickness, and variable thickness plane solids, with different orthotropic,  
elastic-plastic, temperature dependent material properties in tension and compres-  
sion including the effect of either initial strains or stresses. The continuous  
solid is replaced by a system of discrete finite elements having either triangular  
or quadrilateral cross sections. The solution of the continuous solid is reduced  
to the solution of a set of linear, algebraic simultaneous equations yielding the  
displacements, from which the strains and stresses are determined. In Volume II  
(Pre- and Post-processor Theoretical and Programmers' Manual), the theoretical  
background of the pre-processor computer programs MESHGN, TEMINT, and PRSINT and  
the post-processor computer programs ITEROG and CONTUR which are compatible with  
the finite element computer program DOASIS are described. In Volume III (Users'  
Manual), the computer program input data and formats are described for the pre-  
processor computer programs MESHGN, TEMINT, and PRSINT and the post-processor  
ITEROG and CONTUR programs, and for the element computer program DOASIS.

V II: AD A 018 886  
V III: AD A 018 861  
October 1975

REPORT NO: AFML-TR-75-42, Vol. II  
ACCESS NO: 204,110  
TITLE: PROCEEDINGS OF THE 1974 TRISERVICE CORROSION  
OF MILITARY EQUIPMENT CONFERENCE, 29-31 OCTOBER,  
1974, VOLUME II: SESSION IV THROUGH VII

September 1975

AFML/MX

AUTHOR(S): F. Meyer, Editor  
CONTRACT NO: N/A  
CONTRACTOR: internal  
PROJECT MONITOR: F. Meyer (AFML/MXE)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: This report is a compilation of papers presented at the 1974 Triservice Corrosion of Military Equipment Conference held in Dayton, Ohio, 29-31 October, 1974. The purpose of the 1974 Conference was to continue inter-service coordination in the areas of corrosion research and corrosion prevention and control. Specifically, the objectives were to make Department of Defense personnel, contractors, and interested individuals aware of the important corrosion problems in military equipment, to present the status of significant corrosion research projects currently pursued by the military services and to provide a general forum for exchange of corrosion prevention and control information.

REPORT NO: AFML-TR-75-45 AD B 005 923 L  
ACCESS NO: 203,760 May 1975  
TITLE: EXPLORATORY DEVELOPMENT TO OBTAIN THERMAL AND MECHANICAL CHARACTERIZATION DATA ON ADVANCED CARBON INSULATION  
AUTHOR(S): C. Kistler, K. Wilkes, et al.  
CONTRACT NO: AFML-F33615-73-C-5096  
CONTRACTOR: Battelle Columbus Laboratories  
PROJECT MONITOR: C. Pratt (AFML/MXS)  
DIST. STATEMENT: U.S. Govt. Agencies Only  
ABSTRACT: This report summarizes characterization methods and data for carbon fiber insulation considered for use in carbon/carbon reentry vehicles. In particular, this report includes microstructural characterization methods, mechanical compressive properties, thermophysical properties, high-temperature carbon/nitrogen reactions, and a survey of potential insulation suppliers.

REPORT NO: AFML-TR-75-58 AD A 013 877  
ACCESS NO: 203,806 May 1975  
TITLE: DETERMINATION OF SELECTED MIL-HDBK-5 DESIGN ALLOWABLE PROPERTIES FOR FIVE AEROSPACE MATERIALS  
AUTHOR(S): P. Ruff  
CONTRACT NO: F33615-73-C-5053  
CONTRACTOR: Battelle Columbus Laboratories  
PROJECT MONITOR: C. Harmsworth (AFML/MXE)  
PROJECT NO: 7381  
TASK NO: 73810336  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: This annual report describes a test program to develop certain missing MIL-HDBK-5 design allowable properties for five aerospace materials: 2024-T861 aluminum alloy sheet, 17-4PH and 15-5PH precipitation hardening stainless steel bar, 9Ni-4Co-0.20C steel plate, and Ti-6Al-6V-2Sn annealed extrusion. Design allowable properties were determined in accordance with MIL-HDBK-5 guidelines.

REPORT NO: AFML-TR-75-65 AD A 015 730  
ACCESS NO: 203,889 July 1975  
TITLE: THE EVALUATION OF Ti-6Al-6V-2Sn PRE-ALLOYED POWDER PROCESSING



AFML/MX

AUTHOR(S): C. Cook, A. Vaia  
CONTRACT NO: F33615-73-C-5107  
CONTRACTOR: Westinghouse Research Labs  
PROJECT MONITOR: G. Saul (AFML/MXA)  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: The effects of input material and powder production method on the properties of Ti-6Al-6V-2Sn powder and hot isostatically pressed powder compacts have been evaluated. The variations in input material studied were material form, structure, and chemistry while the two powder production methods examined were the solid state hydride-dehydride (HD) process and the experimental molten state, Westinghouse Durarc<sup>R</sup> Process. The effect of these materials and processing variables on the tensile properties of powder compacts was largely masked by the contamination present in both the HD and Durarc<sup>R</sup> Powder. While both powder processes resulted in oxygen contamination, in Durarc<sup>R</sup> Powder the contamination tended to be localized in some particles and particle surfaces which produced localized brittleness and poor tensile ductility in the subsequent compacts. Metallic inclusions present in HD powder formed brittle reaction zones with the titanium alloy during pressing and heat treating which also resulted in poor tensile ductility in powder compacts.

REPORT NO: AFML-TR-75-76  
ACCESS NO: 204,125  
TITLE: REENTRY VEHICLE NOSETIP STRESS ANALYSIS  
AUTHOR(S): R. Jones, J. Koenig  
CONTRACT NO: N/A  
CONTRACTOR: internal  
PROJECT MONITOR: C. Pratt (AFML/MXS)  
PROJECT NO: 7381  
TASK NO: 738102  
DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: The design analysis problems for graphite and carbon/carbon reentry vehicle nosetips in ballistic and maneuvering trajectories are outlined. The ultimate objective is computer programs for prediction of the thermal and mechanical stress behavior of such nosetips. The steps for qualifying computer programs to attain the objective are discussed in the context of necessary laboratory experiments through flight tests. Present nosetip stress analysis computer programs are characterized, and material behavioral characteristics not properly treated are identified. Some of the problem areas are different tensile and compressive moduli; nonlinear orthotropic behavior including biaxial softening (substantially increased strains under biaxial tensile loading opposed to uniaxial loading); macroscopic inhomogeneity and asymmetry of carbon/carbon nosetips; incompletely characterized materials; and inadequate failure criteria. Future nosetip stress analysis capabilities are speculatively predicted.

REPORT NO: AFML-TR-75-97  
ACCESS NO: 203,980  
TITLE: ENGINEERING DATA ON NEW AEROSPACE STRUCTURAL MATERIALS  
AUTHOR(S): O. Deel, P. Ruff, H. Mindlin  
CONTRACT NO: F33615-73-C-5073  
CONTRACTOR: Battelle Laboratories  
PROJECT MONITOR: C. Harmsworth (AFML/MXE)  
PROJECT NO: 7381  
TASK NO: 738106  
DIST. STATEMENT: Approved for public release; distribution unlimited.

**ABSTRACT:** The major objectives of this research program were to evaluate newly developed materials of interest to the Air Force for potential structural airframe usage, and to provide "data sheet" type presentations of engineering data for these materials. The effort covered in this report has concentrated on 7049-T7351 plate, Inconel 617 annealed sheet, 7475-T7351 plate, 2419-T851 plate, Ti-6Al-2Zr-2Sn-2Mo-2Cr duplex-annealed forging, Ti-6Al-2Cb-1Ta-1Mo annealed plate, Ti-6Al-4V beta-annealed plate, Ti-6Al-4V annealed castings, Ti-6Al-4V isothermal forgings, Incoloy 903 heat-treated sheet, and 201.0 T7 castings.

**REPORT NO:** AFML-TR-75-117 **AD B 007 942**  
**ACCESS NO:** 204,033 **September 1975**  
**TITLE:** MICROSTRUCTURAL RELATIONSHIPS IN 2-2-3  
 CARBON REINFORCED CARBON COMPOSITES  
**AUTHOR(S):** R. McSwain, C. Bates  
**CONTRACT NO:** F33615-74-C-5029  
**CONTRACTOR:** Southern Research Institute  
**PROJECT MONITOR:** Capt. E. Ross (AFML/MXS)  
**DIST. STATEMENT:** U.S. Govt. Agencies Only  
**ABSTRACT:** Several 2-2-3 carbon reinforced carbon composites have been examined using light microscopy, scanning electron microscopy, and transmission electron microscopy to determine the structural relationships existing between Thornel 50 carbon fibers, chemically vapor deposited pyrolytic carbon, and a pitch impregnant. It was found that the vapor deposited carbon existed on the Thornel fibers within the yarn bundles with the c-axis of the deposited carbon parallel to the fiber axis. After CVD (chemical vapor deposition) treatment, impregnation, and graphitization, the filler material within fiber bundles exists with the c-axis of the graphite filler parallel to the fiber bundle axis.

**REPORT NO:** AFML-TR-75-125 **October 1975**  
**ACCESS NO:** 203,997  
**TITLE:** A STUDY OF FRACTURE MECHANICS FOR GRAPHITIC MATERIALS  
**AUTHOR(S):** A. Cull, H. Starrett  
**CONTRACT NO:** F33615-73-C-5109  
**CONTRACTOR:** Southern Research Institute  
**PROJECT MONITOR:** Lt. T. Hinnerichs (AFML/MXS)  
**DIST. STATEMENT:** U.S. Govt. Agencies Only  
**ABSTRACT:** The purpose of this research is to study the fracture behavior of graphitic materials by the application and development of the techniques of fracture mechanics. Two materials are involved: ATJ-S (WS) graphite and MOD 3a carbon composite. Both compliance calibration and theoretical K-solutions were used to determine the fracture toughness and the stress intensity factor for ATJ-S (WS). The calculations are based on the maximum load and the initial compliance of the "load/load line deflection" curves of compact, fracture toughness specimens. A preliminary K-model for the T/S test was developed from a known solution by an experimental procedure. It was used to evaluate data collected from tests on slit, T/S specimens. The stress intensity factor value so determined is in general agreement with that of the fracture toughness tests.

**REPORT NO:** AFML-TR-75-136 **AD A 018 159**  
**ACCESS NO:** 204,031 **September 1975**  
**TITLE:** MECHANICAL PROPERTY DATA FOR ALUMINUM ALLOY 2419-T851 PLATE

AUTHOR(S): J. Ruschau  
 CONTRACT NO: F33615-74-C-5024  
 CONTRACTOR: University of Dayton  
 PROJECT MONITOR: D. Watson (AFML/MXE)  
 PROJECT NO: 7381  
 TASK NO: 738106  
 DIST. STATEMENT: Approved for public release; distribution unlimited.  
 ABSTRACT: Tensile properties, fracture toughness, fatigue, fatigue crack growth, and stress corrosion properties for aluminum alloy/temper 2419-T851 two-inch-thick-plate were determined. The material was obtained from the Aluminum Company of America. Material property comparisons were then drawn between data developed from a single plate of the test alloy and aluminum alloy 2219 plate in the T851 heat treat condition. Material property comparisons indicate the two alloys possess very similar tensile properties, comparable fatigue crack growth rate properties, and similar fracture toughness properties. Notched ( $K_t=3.0$ ) fatigue results for alloy 2419 coincide with those found for alloy 2219, while smooth fatigue results for 2419 were superior to 2219. Aluminum alloy 2419-T851 also demonstrated excellent resistance to stress corrosion cracking.

REPORT NO: AFML-TR-75-137 AD A 019 412  
 ACCESS NO: 204,109 September 1975  
 TITLE:

THE STUDY OF THE EFFECT OF SHOCK INTERACTION  
 ON AXISYMMETRIC CONCAVE CONIC SHAPES IN  
 HYPERSONIC FLOW

AUTHOR(S): B. Richards, M. Kenworthy  
 CONTRACT NO: AFOSR-72-2227  
 CONTRACTOR: von Karman Institute for Fluid Dynamics  
 PROJECT MONITOR: Capt. G. Jumper, Capt. E. Heinonen (AFML/MXS)  
 DIST. STATEMENT: Approved for public release; distribution unlimited.  
 ABSTRACT: Heat transfer and pressure distributions have been measured on three concave biconic configurations in the von Karman Institute Longshot free piston wind tunnel at  $M=15$  and 20. The test flow parameters achieved closely simulate aerodynamic re-entry conditions. Information derived from the measurements and also single spark and high speed cone schlieren flow visualization photographs enabled a qualitative description of the complicated two-shock steady flow system to be made and to explain the reason for the very high pressures and heat transfer rates measured on the concave surface. The effect of changing tip geometry, surface roughness, model incidence, and flow conditions on the interaction is examined experimentally.

REPORT NO: AFML-TR-75-138 AD A 019 781  
 ACCESS NO: 204,113 September 1975  
 TITLE:

A STUDY OF THE UNSTEADY FLOW OVER CONCAVE  
 CONIC MODELS AT MACH 15

AUTHOR(S): M. Kenworthy, B. Richards  
 CONTRACT NO: AFOSR-72-2227  
 CONTRACTOR: von Karman Institute for Fluid Dynamics  
 PROJECT MONITOR: Capt. G. Jumper, Capt. E. Heinonen (AFML/MXS)  
 DIST. STATEMENT: Approved for public release; distribution unlimited.



**ABSTRACT:** Pressure measurements and high speed cone schlieren photography have been used to study the unsteady flow behavior of the Mach 15 and 20 flow over families of concave conic model shapes. The test flow parameters achieved closely simulate aerodynamic reentry conditions. The unsteady flow behavior was found to resemble that found on certain configurations of spike cones. The shape of the concave surface and the Reynolds number were found to be important parameters controlling the type of instability. Further test programs are considered necessary to understand the flow processes and to define the boundaries of the instabilities.

REPORT NO: AFML-TR-75-139 AD A 018 805  
 ACCESS NO: 203,628 September 1975  
 TITLE: BOUNDARY LAYER TRANSITION ON BLUNT BODIES  
 IN HYPERSONIC FLOW  
 AUTHOR(S): B. Richards  
 CONTRACT NO: AFOSR-72-2227  
 CONTRACTOR: von Karman Institute for Fluid Dynamics  
 PROJECT MONITOR: Capt. G. Jumper, Capt. E. Heinonen (AFML/MXS)  
 DIST. STATEMENT: Approved for public release; distribution unlimited.  
 ABSTRACT: Heat transfer and pressure distributions have been measured on a family of smooth and rough  $50^\circ$  -  $8^\circ$  biconic models in the  $M=15$  to  $20$ ,  $Re/ft=2.0 \times 10^6$  flow simulating re-entry flow and achieved in the von Karman Institute's Longshot facility. The test conditions were selected to generate boundary layer transition data on these models. The heat transfer measurements agreed reasonably well with reference enthalpy prediction methods except for 0.004-inch mean element height wall roughness generated turbulent boundary layer cases when 35 per cent higher values than theory were measured. Transition occurred on the  $50^\circ$  half angle cone forebody in the region of  $270 < Re_k < 400$  or  $10^5 < Re_s < 2.5 \times 10^5$  for smooth surfaced models and  $170 < Re_k < 300$  and  $4 \times 10^4 < Re_s < 10^5$  for rough surfaced models. The Reynolds number range of the roughness height  $k$  on the rough models was  $83 < Re_k < 500$ .

REPORT NO: AFML-TR-75-158  
 ACCESS NO: 203,983 August 1975  
 TITLE: ADHESIVE BONDED AEROSPACE STRUCTURES  
 STANDARDIZED REPAIR HANDBOOK  
 AUTHOR(S): J. McCarthy, R. Horton, et al.  
 CONTRACT NO: F33615-73-C-5171  
 CONTRACTOR: Boeing Commercial Airplane Co.  
 PROJECT MONITOR: W. Scardino (AFML/MXE)  
 PROJECT NO: 7381  
 TASK NO: 738106  
 DIST. STATEMENT: Approved for public release; distribution unlimited.  
 ABSTRACT: This report covers the second phase of a five-phase program to develop a standardized handbook for the repair of bonded aircraft structure. Tasks included the standardization of small repairs that are now covered by the various aircraft technical orders as well as general instructions for large repair work, including component rebuilding. Work completed in Phase II included the selection of standard procedures for small area repairs. Considerable progress was made in evaluating adhesives and surface preparation methods for bond strength and durability. At the conclusion of Phase II, a workshop was held at Dayton with military repair depot personnel and industry representatives. Inputs on key program items were received, which will establish direction for future program tasks.

AFML/MX

REPORT NO: AFML-TR-75-159  
ACCESS NO: REF 263  
TITLE: SEM/TEM FRACTOGRAPHY HANDBOOK  
AUTHOR(S): G. Pittinato, et al.  
CONTRACT NO: F33615-74-C-5004  
CONTRACTOR: McDonnell Douglas Astronautics Co.  
PROJECT MONITOR: R. Henderson (AFML/MXA)  
PROJECT NO: 7381  
TASK NO: 738103

MCIC-HB-06  
December 1975

DIST. STATEMENT: Approved for public release; distribution unlimited.  
ABSTRACT: The SEM/TEM Electron Fractography Handbook was prepared with the primary intent of assisting in service failure analyses. The handbook consists of three separate sections. Section I describes the basic techniques used in handling and preparing specimens for electron fractography. Only those techniques that are routinely used in fracture surface analyses are discussed. In Section II of the handbook, the fracture surface characteristics and mechanisms associated with the different fracture modes are examined and illustrated. A discussion is given on the four principal fracture modes: dimple rupture, cleavage, fatigue, and decohesive rupture. Representative SEM and TEM fractographs depicting these fracture modes are also included in this section. Section III contains SEM and TEM electron fractographs of numerous alloys that were fractured under controlled conditions. This atlas of electron fractographs is organized by alloy type, and within each alloy subsection, by the specific test conditions that produced the fracture. Each test condition is introduced by a data page that contains the material form, heat treatment, test conditions and results, a macrophotograph showing the fracture surface features. On subsequent pages, SEM and TEM fractographs showing prominent fracture features are presented. For all of the alloys, a reference microstructure is included with the respective smooth tensile data.

# SUBJECT INDEX

The subject index is presented as a Keyword-Out-of-Context (KWOC) index. Each significant title word is displayed in alphabetic order to the left of the page. The full title is displayed in the middle of the page. The right hand column shows the access number and page number in the report on which the abstract itself appears.

KWOC ENTRY	TITLE	ACCESS NO./ Page No./
BRAZING	LOW-TEMPERATURE LARGE-AREA BRAZING OF TITANIUM STRUCTURES	201790/014
.	.	.
.	.	.
.	.	.
.	.	.
.	.	.
TITANIUM	LOW-TEMPERATURE LARGE-AREA BRAZING OF TITANIUM STRUCTURES	201790/014



ABLATION	THE CARBON/CARBON ASSESSMENT PROGRAM 50 MW ABLATION TESTING AND RESULTS	204048/065
ABLATION	EX DEV OF HYPERSONIC HEAT TRANSFER AND THERMOCHEMICAL ABLATION OF ADV MATLS NOSETIP TEST DATA EVAL AND ROUGH WALL TRANSITION	203847/069
ABLATION	EXPLORATORY DEVELOPMENT OF HYPERSONIC HEAT TRANSFER AND THERMOMECHANICAL ABLATION OF ADVANCED MATERIALS	203847/070
ABLATION	THERMOCHEMICAL ABLATION OF AROMATIC/HETEROCYCLIC POLYMERIC COMPOSITES PART III MATERIAL ELEMENTAL COMPOSITION PERFORMANCE OPTIMIZATION	203434/042
ABLATIVE	ADVANCED ABLATIVE HEATSHIELDS FOR REENTRY MISSILES PT I LOW RECESSION/HIGH STRENGTH PIO MATRIX FABRICATION STUDY	204009/052
ABSTRACTS	ABSTRACTS OF AF MATERIALS LABORATORY REPORTS JANUARY 1974-DECEMBER 1974	204111/001
ABSTRACTS	ABSTRACTS OF ACTIVE CONTRACTS AIR FORCE MATERIALS LABORATORY	204023/001
AC	AC LOSS AS A FUNCTION OF CURRENT AND EXTERNAL MAGNETIC FIELD IN COMMERCIAL NBTI SUPERCONDUCTORS	203798/026
ACCELERATED	ACCELERATED CHARACTERIZATION OF FIBER/EPOXY COMPOSITES PT I VISCOELASTIC METHODS	203433/052
ACQUISITION	DATA ACQUISITION AND ANALYSIS OF LONG-TERM THERMO-AGING DEGRADATION DATA	203762/001
ACTIVATED	MANUFACTURING METHODS FOR LOW EMISSION GRID COATINGS FOR BARIUM ACTIVATED CATHODE VACUUM TUBES	203455/033
ACTIVE	ABSTRACTS OF ACTIVE CONTRACTS AIR FORCE MATERIALS LABORATORY	204023/001
ADAPTIVE	ADAPTIVE NONLINEAR SIGNAL PROCESSING FOR CHARACTERIZATION OF ULTRASONIC NDE WAVEFORMS TASK I INFERENCE OF FLATBOTTOM HOLE SIZE	203736/012
ADDITION-CURED	DEVELOPMENT OF HIGH TEMPERATURE ADDITION-CURED ADHESIVES	204032/061

ADHESIVE	THE ROLE OF TRANSIENT SPECTRUM AND DAMPING ANALYSIS IN ASSESSING THE STRENGTH OF POLYMERIC ADHESIVE METAL BONDING	203522/010
ADHESIVE	ADHESIVE BONDED AEROSPACE STRUCTURES STANDARDIZED REPAIR HANDBOOK	203983/075
ADHESIVE	STRESSES IN AN ADHESIVE BONDED COMPOSITE-TO-METAL ASSEMBLY	203773/068
ADHESIVE	DURABILITY OF ADHESIVE BONDED JOINTS	203456/068
ADHESIVES	DEVELOPMENT OF HIGH TEMPERATURE ADDITION-CURED ADHESIVES	204032/061
ADHESIVES	PPQ ADHESIVES FOR LARGE AREA BONDING OF TITANIUM ALLOYS	204106/062
ADHESIVES	DEVELOPMENT OF IMPROVED CORE SPLICE ADHESIVES	204005/056
ADV	EX DEV OF HYPERSONIC HEAT TRANSFER AND THERMOCHEMICAL ABLATION OF ADV MATLS NOSETIP TEST DATA EVAL AND ROUGH WALL TRANSITION	203847/069
AEROSPACE	ADHESIVE BONDED AEROSPACE STRUCTURES STANDARDIZED REPAIR HANDBOOK	203983/075
AEROSPACE	ENGINEERING DATA ON NEW AEROSPACE STRUCTURAL MATERIALS	203980/072
AEROSPACE	DETERMINATION OF SELECTED MIL-HDBK-5 DESIGN ALLOWABLE PROPERTIES FOR FIVE AEROSPACE MATERIALS	203806/071
AEROSPACE	AEROSPACE MATERIALS RESPONSE TO INTENSE THERMAL RADIATION	204108/060
AEROSPACE	RADIANT HEATING OF AEROSPACE MATERIALS PT II LASER EFFECTS PREDICTION PROCEDURE CODE	204003/046
AF	ABSTRACTS OF AF MATERIALS LABORATORY REPORTS JANUARY 1974-DECEMBER 1974	204111/001
AGING	FRACTURE TOUGHNESS AGING BEHAVIOR GRAIN GROWTH AND HARDNESS OF ALPHA-BETA TITANIUM ALLOYS	202433/004
AGING	FRACTURE TOUGHNESS AND AGING BEHAVIOR OF ALPHA-BETA TITANIUM ALLOYS	204092/017

AIR	DEVELOPMENT OF LIQUID CRYSTAL SYSTEMS FOR AIR FORCE DISPLAY APPLICATIONS	204093/027
AIR	EXPLORATORY DEVELOPMENT OF MAGNETIC BUBBLE DOMAIN MATERIAL FOR APPLICATION IN AIR FORCE SOLID STATE MASS MEMORY SYSTEMS	203799/035
AIR	ABSTRACTS OF ACTIVE CONTRACTS AIR FORCE MATERIALS LABORATORY	204023/001
AIR	SUMMARY REPORT ON THE AIR FORCE/INDUSTRY COST REDUCTION PROGRAM RADAR PANEL PHASE II	204123/040
AIRCRAFT	RELIABILITY ASSESSMENT OF AIRCRAFT STRUCTURES BASED ON PROBABILISTIC INTERPRETATION OF THE SCATTER FACTOR	203804/005
AIRCRAFT	PROGRAM TO IMPROVE THE FRACTURE TOUGHNESS AND FATIGUE RESISTANCE OF ALUMINUM SHEET AND PLATE FOR AIRCRAFT APPLICATIONS	202045/004
AIRCRAFT	LOW COST MANUFACTURING CONCEPTS OF ADVANCED COMPOSITE PRIMARY AIRCRAFT	203059/039
AIRCRAFT	LONG LIFE ELASTOMERIC AIRCRAFT HYDRAULIC SEALS	203217/044
AIRCRAFT	MANUFACTURING METHODS FOR THERMAL EXPANSION MOLDING OF ADVANCED COMPOSITES AIRCRAFT STRUCTURE	203128/038
AIRCRAFT	MANUFACTURING METHODS FOR FABRICATION AND ASSEMBLY OF ADVANCED COMPOSITE PRIMARY AIRCRAFT STRUCTURE	202878/038
AIRCRAFT	HYBRID FLUOROSILICONES FOR AIRCRAFT FUEL TANK SEALANTS	203981/041
AIRCRAFT	THERMAL FLASH RESISTANT IR SUPPRESSION COATINGS FOR ADVANCED AIRCRAFT SYSTEMS	203750/050
AIRFRAME	NONDESTRUCTIVE TESTING OF DIFFUSION BONDED TITANIUM ALLOYS FOR ENGINE AND AIRFRAME COMPONENTS	203842/006
AIRFRAME	RESEARCH ON DEEP HARDENING TITANIUM ALLOY FOR LARGE AIRFRAME STRUCTURAL MEMBERS	203925/013



ALKALI	PROTECTIVE-ANTIREFLECTIVE THIN FILMS FOR POLYCRYSTALLINE ZINC SELENIDE AND ALKALI HALIDE LASER WINDOWS	203173/025
ALLOWABLE	DETERMINATION OF SELECTED MIL-HDBK-5 DESIGN ALLOWABLE PROPERTIES FOR FIVE AEROSPACE MATERIALS	203806/071
ALPHA-BETA	FRACTURE TOUGHNESS AND AGING BEHAVIOR OF ALPHA-BETA TITANIUM ALLOYS	204092/017
ALPHA-BETA	FRACTURE TOUGHNESS, AGING BEHAVIOR, GRAIN GROWTH AND HARDNESS OF ALPHA-BETA TITANIUM ALLOYS	202433/004
ALUMINUM	INFLUENCE OF IRON AND SILICON CONTENT ON THE TENSILE PROPERTIES OF 7X75 AND 72-MOLDED 7X75 ALUMINUM PLATE	204007/019
ALUMINUM	EFFECTS OF PURITY AND PROCESSING ON THE EXFOLIATION CORROSION BEHAVIOR OF 7X75 ALUMINUM PLATE	203885/014
ALUMINUM	DETERMINATION OF STRESS INTENSITY FACTOR FOR COLD-WORKED FASTENER HOLES IN 7075 ALUMINUM USING THE CRACK GROWTH METHOD	203820/010
ALUMINUM	STRENGTH CHARACTERISTICS OF BORON ALUMINUM COMPOSITE SUBJECTED TO COMBINED STRESSES	203507/006
ALUMINUM	PRACTICAL SENSITIVITY LIMITS OF PRODUCTION NONDESTRUCTIVE TESTING METHODS IN ALUMINUM AND STEEL	203852/007
ALUMINUM	PROGRAM TO IMPROVE THE FRACTURE TOUGHNESS AND FATIGUE RESISTANCE OF ALUMINUM SHEET AND PLATE FOR AIRCRAFT APPLICATIONS	202045/004
ALUMINUM	BORON ALUMINUM TITANIUM HYBRID COMPOSITES	203824/007
ALUMINUM	MECHANICAL PROPERTY DATA FOR ALUMINUM ALLOY 2419-T851 PLATE	204031/073
ALUMINUM	STATIC AND DYNAMIC FRACTURE PROPERTIES FOR ALUMINUM ALLOY 7475-T651 AND T7351	203783/059
ALUMINUM	DEVELOPMENT OF CORROSION RESISTANT SURFACE TREATMENTS FOR ALUMINUM ALLOYS FOR SPOT-WELD BONDING	204038/058

ALUMINUM	SURFACE ANALYSIS OF 2024 AND 7075 ALUMINUM ALLOYS AFTER CONDITIONING BY CHEMICAL TREATMENTS	204107/062
ANTENNA	INVESTIGATION OF GAGE AND BEARING INSTABILITY IN DESPUN ANTENNA BEARINGS DUE TO CHANGES IN LUBRICANT PROPERTIES	203888/055
APPLICATION	EXPLORATORY DEVELOPMENT OF MAGNETIC BUBBLE DOMAIN MATERIAL FOR APPLICATION IN AIR FORCE SOLID STATE MASS MEMORY SYSTEMS	203799/035
APPLICATION	ON THE SHAPE OF ERODING BODIES WITH APPLICATION TO BALLISTIC RANGE EROSION TESTS	204103/063
APPLICATIONS	DEVELOPMENT OF CHALCOPYRITE CRYSTALS FOR NONLINEAR OPTICAL APPLICATIONS	069009/022
APPLICATIONS	DEVELOPMENT OF LIQUID CRYSTAL SYSTEMS FOR AIR FORCE DISPLAY APPLICATIONS	204093/027
APPLICATIONS	PROGRAM TO IMPROVE THE FRACTURE TOUGHNESS AND FATIGUE RESISTANCE OF ALUMINUM SHEET AND PLATE FOR AIRCRAFT APPLICATIONS	202045/004
APPLICATIONS	MANUFACTURING METHODS TO PRODUCE HIGH DIELECTRIC CONSTANT MATERIALS FOR MICROWAVE APPLICATIONS	204101/038
APPROACHES	MATERIALS AND APPROACHES FOR IMPROVED STRESS CORROSION INHIBITIVE COATINGS	203218/043
AREA	200 ADHESIVES FOR LARGE AREA BONDING OF TITANIUM ALLOYS	204106/062
AROMATIC	APPARATUS AND TECHNIQUES USED FOR CASTING FILMS OF AROMATIC HETEROCYCLIC POLYMERS	203572/052
AROMATIC/HETERO	THERMOCHEMICAL ABLATION OF AROMATIC/HETEROCYCLIC POLYMERIC COMPOSITES PART III MATERIAL ELEMENTAL COMPOSITION PERFORMANCE OPTIMIZATION	203434/042
ARRAY	PLATED WIRE MASS MEMORY ARRAY MANUFACTURING METHODS	203884/032
ARREST	CRACK ARREST IN TITANIUM	203886/017
ARSENIDE	DEVELOPMENT OF GALLIUM ARSENIDE FOR INFRARED WINDOWS	203821/027

ASSEMBLY	STRESSES IN AN ADHESIVE BONDED COMPOSITE-TO-METAL ASSEMBLY	203773/068
ASSEMBLY	MANUFACTURING METHODS FOR FABRICATION AND ASSEMBLY OF ADVANCED COMPOSITE PRIMARY AIRCRAFT STRUCTURE	202878/038
ASSESSING	THE ROLE OF TRANSIENT SPECTRUM AND DAMPING ANALYSIS IN ASSESSING THE STRENGTH OF POLYMERIC ADHESIVE METAL BONDING	203522/010
ASSESSMENT	RELIABILITY ASSESSMENT OF AIRCRAFT STRUCTURES BASED ON PROBABILISTIC INTERPRETATION OF THE SCATTER FACTOR	203804/005
ASSESSMENT	RELIABILITY AND RISK ASSESSMENT METHODS AND REDUNDANT STRUCTURES	204096/003
ASSESSMENT	THE CARBON/CARBON ASSESSMENT PROGRAM 50 MW IRRADIATION TESTING AND RESULTS	204048/065
ASSURANCE	LIFE ASSURANCE OF COMPOSITE STRUCTURES VOL 1 MOISTURE EFFECTS	203825/002
ATJ-S	IMPROVED ATJ-S GRAPHITE PT I MATERIALS AND PROCESS STUDIES	203347/047
ATJ-S	ELASTIC COMPLIANCES FOR ATJ-S GRAPHITE AND MOD 3A CARBON/CARBON	203341/067
ATJ-S	BIAXIAL TENSILE FRACTURE OF ATJ-S GRAPHITE	203720/066
AUTOMATED	AUTOMATED DIRECTIONAL SOLIDIFICATION OF SUPERALLOYS	204102/040
AXISYMMETRIC	THE STUDY OF THE EFFECT OF SCHOCK INTERACTION ON AXISYMMETRIC CONCAVE CONIC SHAPES IN HYPERSONIC FLOW	204109/074
AXISYMMETRIC	DOASIS A COMPUTER CODE FOR THE DEFORMATION PLASTIC ORTHOTROPIC AXISYMMETRIC AND PLANE SOLUTION OF INELASTIC SOLIDS	204136/070
BALL	PLANETARY BALL SWAGING OF WELDED TITANIUM ALLOY TUBING	067738/031
BALL	PERFORMANCE OF LUBRICANTS OILS AND GREASES IN WEAR TESTS AND COMPACT MATERIALS IN BALL BEARINGS	203570/055



BALLISTIC	ON THE SHAPE OF ERODING BODIES WITH APPLICATION TO BALLISTIC RANGE EROSION TESTS	204103/063
BAR	INSTRUMENTED IMPACT TESTING USING A HOPKINSON BAR APPARATUS	203822/015
BARIUM	MANUFACTURING METHODS FOR LOW EMISSION GRID COATINGS FOR BARIUM ACTIVATED CATHODE VACUUM TUBES	203455/033
BBB	MANUFACTURING METHODS FOR BBB FIBER	201112/036
BBB	SYNTHESIS OF OXYARYLENE BBB POLYMERS	203897/053
BEARING	EFFECT OF BEARING DEFECTS	200652/035
BEARING	INVESTIGATION OF CAGE AND BEARING INSTABILITY IN DESPUN ANTENNA BEARINGS DUE TO CHANGES IN LUBRICANT PROPERTIES	203888/055
BEARING	DEVELOPMENT OF BEARING AND LUBRICANT TEST EQUIPMENT	203459/046
BEARINGS	PERFORMANCE OF LUBRICANTS OILS AND GREASES IN WEAR TESTS AND COMPACT MATERIALS IN BALL BEARINGS	203570/055
BEARINGS	INVESTIGATION OF CAGE AND BEARING INSTABILITY IN DESPUN ANTENNA BEARINGS DUE TO CHANGES IN LUBRICANT PROPERTIES	203888/055
BERYLLIUM	MECHANICAL PROPERTIES OF STRUCTURAL GRADES OF BERYLLIUM AT HIGH STRAIN RATES	204099/020
BERYLLIUM	EFFECT OF PLASTIC PRESTRAIN ON THE TENSILE STRAIN TO FAILURE OF BERYLLIUM	203844/015
BERYLLIUM	NOTCH TENSILE STRENGTH OF ADVANCED STRUCTURAL GRADES OF BERYLLIUM	203675/007
BERYLLIUM	DYNAMIC COMPRESSIVE STRAIN RATE TESTS ON SEVERAL GRADES OF BERYLLIUM	203344/006
BETA	EFFECT OF OMEGA PHASE ON SELECTED PROPERTIES OF BETA III TITANIUM ALLOY	203845/013
BIAXIAL	BIAXIAL TENSILE FRACTURE OF ATJ-S GRAPHITE	203720/066

BIBENZOXAZOLE	MOLECULAR TAILORING OF FLUOROCARBON ETHER BIBENZOXAZOLE POLYMERS TO LOWER GLASS TRANSITION TEMPERATURES	204008/054
BILLET	DEVELOPMENT OF HOT ISOSTATIC PRESSING TECHNIQUES FOR PRODUCING HIGH QUALITY BILLET FROM TITANIUM ALLOY POWDER	203881/012
BIPOLAR	COMPLEMENTARY BIPOLAR TRANSISTOR STRUCTURES	203995/031
BLADE	MANUFACTURING METHODS FOR ENGINE BLADE REPAIR	201540/034
BLOCK	NOVEL BLOCK COPOLYMERS	203412/046
BLUNT	BOUNDARY LAYER TRANSITION ON BLUNT BODIES IN HYPERSONIC FLOW	203628/075
BODIES	BOUNDARY LAYER TRANSITION ON BLUNT BODIES IN HYPERSONIC FLOW	203628/075
BODIES	ON THE SHAPE OF ERODING BODIES WITH APPLICATION TO BALLISTIC RANGE EROSION TESTS	204103/053
BONDED	NONDESTRUCTIVE TESTING OF DIFFUSION BONDED TITANIUM ALLOYS FOR ENGINE AND AIRFRAME COMPONENTS	203842/006
BONDED	ADHESIVE BONDED AEROSPACE STRUCTURES STANDARDIZED REPAIR HANDBOOK	203983/075
BONDED	DURABILITY OF ADHESIVE BONDED JOINTS	203456/058
BONDED	STRESSES IN AN ADHESIVE BONDED COMPOSITE-TO-METAL ASSEMBLY	203773/068
BONDING	THE ROLE OF TRANSIENT SPECTRUM AND DAMPING ANALYSIS IN ASSESSING THE STRENGTH OF POLYMERIC ADHESIVE METAL BONDING	203522/010
BONDING	PPQ ADHESIVES FOR LARGE AREA BONDING OF TITANIUM ALLOYS	204106/052
BONDING	DEVELOPMENT OF CORROSION RESISTANT SURFACE TREATMENTS FOR ALUMINUM ALLOYS FOR SPOT-WELD BONDING	204038/058
BORON	LOW COST BORON FILAMENT	203853/036
BORON	BORON ALUMINUM TITANIUM HYBRID COMPOSITES	203824/007

BORON	STRENGTH CHARACTERISTICS OF BORON ALUMINUM COMPOSITE SUBJECTED TO COMBINED STRESSES	203507/006
BORON	MATERIALS VARIABLES AFFECTING THE IMPACT RESISTANCE OF GRAPHITE AND BORON COMPOSITES PART II	203894/048
BORON	MATERIALS VARIABLES AFFECTING THE IMPACT RESISTANCE OF GRAPHITE AND BORON COMPOSITES	203306/048
BOUNDARY	BOUNDARY LAYER TRANSITION ON BLUNT BODIES IN HYPERSONIC FLOW	203628/075
BRAZING	LOW-TEMPERATURE LARGE-AREA BRAZING OF TITANIUM STRUCTURES	201790/014
BUBBLE	EXPLORATORY DEVELOPMENT OF MAGNETIC BUBBLE DOMAIN MATERIAL FOR APPLICATION IN AIR FORCE SOLID STATE MASS MEMORY SYSTEMS	203799/035
BULK	DEVELOPMENT OF A GAS TURBINE ENGINE OIL FOR BULK OIL TEMPERATURES OF -40 TO 465 F	203680/051
CADMIUM	CHEMICAL VAPOR DEPOSITION OF CADMIUM TELLURIDE	203682/028
CAGE	INVESTIGATION OF CAGE AND BEARING INSTABILITY IN DESPUN ANTENNA BEARINGS DUE TO CHANGES IN LUBRICANT PROPERTIES	203888/055
CALASOAP ND	PERFECTION OF CALASOAP:ND LASER MATERIAL	203502/024
CALIBRATION	A STRESS INTENSITY FACTOR CALIBRATION FOR CORNER FLAWS AT AN OPEN HOLE	203819/010
CARBON	MICROSTRUCTURAL RELATIONSHIPS IN 2-2-3 CARBON REINFORCED CARBON COMPOSITES	204033/073
CARBON	MICROSTRUCTURAL RELATIONSHIPS IN 2-2-3 CARBON REINFORCED CARBON COMPOSITES	204033/073
CARBON	EXPLORATORY DEVELOPMENT TO OBTAIN THERMAL AND MECHANICAL CHARACTERIZATION DATA ON ADVANCED CARBON INSULATION	203760/071
CARBON/CARBON	THERMOSTRUCTURAL RESPONSE OF CARBON/CARBON MATERIALS UNDER HIGH HEAT FLUX ENVIRONMENTS	203623/065
CARBON/CARBON	THE CARBON/CARBON ASSESSMENT PROGRAM 50 MW ABLATION TESTING AND RESULTS	204048/065



CARBON/CARBON	ELASTIC COMPLIANCES FOR ATJ-S GRAPHITE AND MOD 3A CARBON/CARBON	203341/067
CARBON/PLASTIC	ADVANCED PROTECTIVE MATERIALS FOR PEENTRY MISSILE NOSETIPS PT I THREE DIMENSIONAL REINFORCED CARBON/PLASTIC COMPOSITES	203826/058
CASTING	APPARATUS AND TECHNIQUES USED FOR CASTING FILMS OF AROMATIC HETEROCYCLIC POLYMERS	203572/052
CATHODE	MANUFACTURING METHODS FOR LOW EMISSION GRID COATINGS FOR BARIUM ACTIVATED CATHODE VACUUM TUBES	203455/033
CERAMICS	EXPLORATORY DEVELOPMENT TO STUDY THE LONG-TERM EFFECTS OF RESORBABLE CERAMICS IN PRIMATES	204006/020
CHALCOGENIDE	CHEMICAL VAPOR DEPOSITION OF CHALCOGENIDE SEMICONDUCTORS	204098/029
CHALCOPYRITE	DEVELOPMENT OF CHALCOPYRITE CRYSTALS FOR NONLINEAR OPTICAL APPLICATIONS	069009/022
CHARA	EX OF STAT FATIGUE CHARA OF 0.063-INCH MILL-ANNEALED TI-6AL-4V SHEET AND 0.050-INCH HEAT TREATED 17-7 PH STEEL SHEET UNDER SIM F BY F LOADING	202168/008
CHARACTERISTICS	STRENGTH CHARACTERISTICS OF BORON ALUMINUM COMPOSITE SUBJECTED TO COMBINED STRESSES	203507/006
CHARACTERISTICS	CRACK PROPAGATION CHARACTERISTICS IN THREE DEEP HARDENABLE TITANIUM ALLOYS	204112/016
CHARACTERIZATIO	BASIC RESEARCH ON LASER PLUME CHARACTERIZATION	203714/009
CHARACTERIZATIO	ADAPTIVE NONLINEAR SIGNAL PROCESSING FOR CHARACTERIZATION OF ULTRASONIC NDE WAVEFORMS TASK I INFERENCE OF FLATBOTTOM HOLE SIZE	203736/012
CHARACTERIZATIO	EXPLORATORY DEVELOPMENT TO OBTAIN THERMAL AND MECHANICAL CHARACTERIZATION DATA ON ADVANCED CARBON INSULATION	203760/071
CHARACTERIZATIO	ACCELERATED CHARACTERIZATION OF FIBER/EPOXY COMPOSITES PT I VISCOELASTIC METHODS	203433/052
CHEMICALTREATME	SURFACE ANALYSIS OF 2024 AND 7075 ALUMINUM ALLOYS AFTER CONDITIONING BY CHEMICAL TREATMENTS	204107/052

CLOTHING	EXPLORATORY DEVELOPMENT OF COATED FABRIC FOR FIREFIGHTERS PROTECTIVE CLOTHING	203891/059
COALESCENCE	DEFORMATION MODE OF VOID-GROWTH AND COALESCENCE IN THE PROCESS OF DUCTILE FRACTURE	203896/017
COATED	EXPLORATORY DEVELOPMENT OF COATED FABRIC FOR FIREFIGHTERS PROTECTIVE CLOTHING	203891/059
COATING	ML-101 THERMAL CONTROL COATING SPACEFLIGHT EXPERIMENT	204133/054
COATINGS	MANUFACTURING METHODS FOR LOW EMISSION GRID COATINGS FOR BARIUM ACTIVATED CATHODE VACUUM TUBES	203455/033
COATINGS	SOME EFFECTS OF ENVIRONMENTAL FACTORS ON THE PERFORMANCE OF COATINGS FOR HIGH POWER IN LASERS	203566/024
COATINGS	HIGH TEMPERATURES STABLE SUBSONIC RAIN EROSION RESISTANT FLUOROELASTOMERS COATINGS DEVELOPMENT	203793/057
COATINGS	NON-SPECULAR COATINGS	204095/053
COATINGS	SKYLAR D024 THERMAL CONTROL COATINGS AND POLYMERIC FILMS EXPERIMENT	203823/059
COATINGS	MATERIALS AND APPROACHES FOR IMPROVED STRESS CORROSION INHIBITIVE COATINGS	203218/043
COATINGS	WATER BASE COATINGS	203416/049
COATINGS	THERMAL FLASH RESISTANT IR SUPPRESSION COATINGS FOR ADVANCED AIRCRAFT SYSTEMS	203750/050
CODE	DOASIS A COMPUTER CODE FOR THE DEFORMATION PLASTIC ORTHOTROPIC AXISYMMETRIC AND PLANE SOLUTION OF INELASTIC SOLIDS	204136/070
CODE	RADIANT HEATING OF AEROSPACE MATERIALS PT II LASER EFFECTS PREDICTION PROCEDURE CODE	204003/046
COLD-WORKED	DETERMINATION OF STRESS INTENSITY FACTOR FOR COLD-WORKED FASTENER HOLES IN 7075 ALUMINUM USING THE CRACK GROWTH METHOD	203820/011
COMMERCIAL	AC LOSS AS A FUNCTION OF CURRENT AND EXTERNAL MAGNETIC FIELD IN COMMERCIAL NBTI SUPERCONDUCTORS	203798/026

COMPACT	PERFORMANCE OF LUBRICANTS OILS AND GREASES IN WEAR TESTS AND COMPACT MATERIALS IN BALL BEARINGS	203570/055
COMPLEMENTARY	COMPLEMENTARY BIPOLAR TRANSISTOR STRUCTURES	203995/031
COMPLEX	MANUFACTURING PROCESS FOR THE DENSIFICATION OF COMPLEX SHAPED WOVEN COMPOSITE PREFORMS	203848/037
COMPLIANCES	ELASTIC COMPLIANCES FOR ATJ-S GRAPHITE AND MOD 3A CARBON/CARBON	203341/067
COMPLIANT	HIGH TEMPERATURE RESISTANT ELASTOMERS OR COMPLIANT POLYMERS	203297/042
COMPOSITE	STRENGTH CHARACTERISTICS OF BORON ALUMINUM COMPOSITE SUBJECTED TO COMBINED STRESSES	203507/006
COMPOSITE	F-15 COMPOSITE WING VOL II DEVELOPMENT AND TEST RESULTS	069613/002
COMPOSITE	ADVANCED DEVELOPMENT ON VULNERABILITY/SURVIVABILITY OF ADVANCED COMPOSITE STRUCTURES	069611/002
COMPOSITE	LIFE ASSURANCE OF COMPOSITE STRUCTURES VOL I MOISTURE EFFECTS	203825/002
COMPOSITE	F-15 COMPOSITE WING VOL I DEVELOPMENT AND TEST RESULTS	069613/002
COMPOSITE	DEVELOPMENT OF ENGINEERING DATA ON THE MECHANICAL AND PHYSICAL PROPERTIES OF ADVANCED COMPOSITE MATERIALS	203772/067
COMPOSITE	MANUFACTURING PROCESS FOR THE DENSIFICATION OF COMPLEX SHAPED WOVEN COMPOSITE PREFORMS	203848/037
COMPOSITE	MANUFACTURING METHODS FOR FABRICATION AND ASSEMBLY OF ADVANCED COMPOSITE PRIMARY AIRCRAFT STRUCTURE	202878/038
COMPOSITE	LOW COST MANUFACTURING CONCEPTS OF ADVANCED COMPOSITE PRIMARY AIRCRAFT	203059/039
COMPOSITES	BORON ALUMINUM TITANIUM HYBRID COMPOSITES	203824/007
COMPOSITES	GROWTH OF MULTICOMPONENT COMPOSITES FROM THE MELT	203880/012



COMPOSITES	MICROSTRUCTURAL RELATIONSHIPS IN 2-2-3 CARBON REINFORCED CARBON COMPOSITES	204033/073
COMPOSITES	ADVANCED PROTECTIVE MATERIALS FOR REENTRY MISSILE NOSETIPS PT I THREE DIMENSIONAL REINFORCED CARBON/PLASTIC COMPOSITES	203826/058
COMPOSITES	CORROSION BEHAVIOR OF METAL FASTENERS IN GRAPHITE EPOXY COMPOSITES	203812/056
COMPOSITES	MANUFACTURING METHODS FOR RAPIDLY CURING ADVANCED COMPOSITES	201787/039
COMPOSITES	THERMOCHEMICAL ABLATION OF AROMATIC/HETEROCYCLIC POLYMERIC COMPOSITES PART III MATERIAL ELEMENTAL COMPOSITION PERFORMANCE OPTIMIZATION	203434/042
COMPOSITES	MANUFACTURING METHODS FOR THERMAL EXPANSION MOLDING OF ADVANCED COMPOSITES AIRCRAFT STRUCTURE	203128/038
COMPOSITES	ACCELERATED CHARACTERIZATION OF FIBER/EPOXY COMPOSITES PT I VISCOELASTIC METHODS	203433/052
COMPOSITES	MATERIALS VARIABLES AFFECTING THE IMPACT RESISTANCE OF GRAPHITE AND BORON COMPOSITES	203306/048
COMPOSITES	MATERIALS VARIABLES AFFECTING THE IMPACT RESISTANCE OF GRAPHITE AND BORON COMPOSITES PART II	203894/048
COMPOSITE-TO-ME	STRESSES IN AN ADHESIVE BONDED COMPOSITE-TO-METAL ASSEMBLY	203773/058
COMPOSITION	THERMOCHEMICAL ABLATION OF AROMATIC/HETEROCYCLIC POLYMERIC COMPOSITES PART III MATERIAL ELEMENTAL COMPOSITION PERFORMANCE OPTIMIZATION	203434/042
COMPRESSIVE	DYNAMIC COMPRESSIVE STRAIN RATE TESTS ON SEVERAL GRADES OF BERYLLIUM	203844/056
COMPUTER	DOASIS A COMPUTER CODE FOR THE DEFORMATION PLASTIC ORTHOTROPIC AXISYMMETRIC AND PLANE SOLUTION OF INELASTIC SOLIDS	204136/075
COMPUTER	COMPUTER ANALYSIS OF THE MASS SPECTRA OF GAS MIXTURES	203894/048
COMPUTERS	SOME GENERAL PROGRAMS FOR DESK TOP COMPUTERS	203894/048

AD-A038 676 AIR FORCE MATERIALS LAB WRIGHT-PATTERSON AFB OHIO  
ABSTRACTS OF AIR FORCE MATERIALS LABORATORY REPORTS. (U)  
SEP 76 T G PURNHAGEN  
UNCLASSIFIED AFML-TR-76-111

AIR FORCE MATERIALS LAB WRIGHT-PATTERSON AFB OHIO  
ABSTRACTS OF AIR FORCE MATERIALS LABORATORY REPORTS. (U)  
SEP 76 T G PURNHAGEN  
AFML-TR-76-111

**F/G 5/2**

**UNCLASSIFIED**

NL

2 OF 3  
AD  
A038676

~~END~~ CONT.

DATE  
FILMED  
5-77

CONCAVE	THE STUDY OF THE EFFECT OF SCHOCK INTERACTION ON AXISYMMETRIC CONCAVE CONIC SHAPES IN HYPERSONIC FLOW	204109/074
CONCAVE	A STUDY OF THE UNSTEADY FLOW OVER CONCAVE CONIC MODELS AT MACH 15	204113/074
CONDUCTOR	EXPLORATORY DEVELOPMENT OF TRANSPARENT CONDUCTOR MATERIALS	203497/025
CONFERENCE	PROCEEDINGS OF THE FOURTH ANNUAL CONFERENCE ON INFRARED LASER WINDOW	204097/028
CONFERENCE	PROCEEDINGS OF THE 1974 TRISERVICE CORROSION OF MILITARY EQUIPMENT CONFERENCE 29-31 OCTOBER 1974 VOL II SESSION IV THROUGH VII	204110/070
CONIC	THE STUDY OF THE EFFECT OF SCHOCK INTERACTION ON AXISYMMETRIC CONCAVE CONIC SHAPES IN HYPERSONIC FLOW	204109/074
CONIC	A STUDY OF THE UNSTEADY FLOW OVER CONCAVE CONIC MODELS AT MACH 15	204113/074
CONSTANT	MANUFACTURING METHODS TO PRODUCE HIGH DIELECTRIC CONSTANT MATERIALS FOR MICROWAVE APPLICATIONS	204101/038
CONTAMINATION	INVESTIGATION OF CONTAMINATION EFFECTS OF THERMAL CONTROL	203574/049
CONTROL	SKYLAB D024 THERMAL CONTROL COATINGS AND POLYMERIC FILMS EXPERIMENT	203823/059
CONTROL	ML-101 THERMAL CONTROL COATING SPACEFLIGHT EXPERIMENT	204133/054
CONTROL	INVESTIGATION OF CONTAMINATION EFFECTS OF THERMAL CONTROL	203574/049
COPOLYMERS	NOVEL BLOCK COPOLYMERS	203412/046
CORE	DEVELOPMENT OF IMPROVED CORE SPLICE ADHESIVES	204005/056
CORROSION	EFFECTS OF PURITY AND PROCESSING ON THE EXFOLIATION CORROSION BEHAVIOR OF 7X75 ALUMINUM PLATE	203885/014



CORROSION	DEVELOPMENT OF CORROSION RESISTANT SURFACE TREATMENTS FOR ALUMINUM ALLOYS FOR SPOT-WELD BONDING	204038/058
CORROSION	CORROSION BEHAVIOR OF METAL FASTENERS IN GRAPHITE EPOXY COMPOSITES	203812/056
CORROSION	PROCEEDINGS OF THE 1974 TRISERVICE CORROSION OF MILITARY EQUIPMENT CONFERENCE 29-31 OCTOBER 1974 VOL II SESSION IV THROUGH VII	204110/070
CORROSION	HYDROFLUOROCARBON SEALANTS WITH IMPROVED LOW TEMPERATURE AND STRESS CORROSION PROPERTIES	203359/044
CORROSION	MATERIALS AND APPROACHES FOR IMPROVED STRESS CORROSION INHIBITIVE COATINGS	203218/043
COST	LOW COST BORON FILAMENT	203853/036
COST	LOW COST MANUFACTURING CONCEPTS OF ADVANCED COMPOSITE PRIMARY AIRCRAFT	203059/039
COST	SUMMARY REPORT ON THE AIR FORCE/INDUSTRY COST REDUCTION PROGRAM RADAR PANEL PHASE II	204123/040
CRACK	CRACK ARREST IN TITANIUM	203886/017
CRACK	CRACK PROPAGATION CHARACTERISTICS IN THREE DEEP HARDENABLE TITANIUM ALLOYS	204112/016
CRACK	THE EFFECTS OF REST-TIME ON FATIGUE CRACK RETARDATION AND OBSERVATIONS	204059/015
CRACK	A PRELIMINARY STUDY OF FATIGUE CRACK RETARDATION USING LASER INTERFEROMETRY TO MEASURE CRACK SURFACE DISPLACEMENTS	203807/005
CRACK	A PRELIMINARY STUDY OF FATIGUE CRACK RETARDATION USING LASER INTERFEROMETRY TO MEASURE CRACK SURFACE DISPLACEMENTS	203807/005
CRACK	DETERMINATION OF STRESS INTENSITY FACTOR FOR COLD-WORKED FASTENER HOLES IN 7075 ALUMINUM USING THE CRACK GROWTH METHOD	203820/010
CRACK	LOW CYCLE FATIGUE CRACK INITIATION STUDY IN RENE 95	204036/011

CRACKED	TWO-DIMENSIONAL STRESS INTENSITY FACTOR SOLUTIONS FOR RADially CRACKED RINGS	204057/018
CRACKING	STRESS-CORROSION CRACKING OF METALLIC MATERIALS PT III HYDROGEN ENTRY AND EMBRITTLEMENT IN STEEL	203562/004
CRITICAL	EXPERIMENTAL HYSTERETIC LOSS FOR A SERIES OF SUPERCONDUCTING FILAMENTARY NBTI WIRES AND A FIELD DEPENDENT CRITICAL STATE MODEL	204035/024
CROSSLINKING	POLYFUNCTIONAL FLUOROCARBON DERIVATIVES FOR CHEMICAL RESISTANT ELASTOMERS AND CROSSLINKING SYSTEMS	203535/050
CRYSTAL	GROWTH OF DOPED AND UNDOPED SINGLE CRYSTAL LASER MATERIALS IN THE SYSTEM (MF2)XX(YF3)1-X	203787/027
CRYSTAL	PYROELECTRIC FILM/LIQUID CRYSTAL DETECTOR FOR 10.6 UM REGION	203442/022
CRYSTAL	DEVELOPMENT OF LIQUID CRYSTAL SYSTEMS FOR AIR FORCE DISPLAY APPLICATIONS	204093/027
CRYSTALS	DEVELOPMENT OF CHALCOPYRITE CRYSTALS FOR NONLINEAR OPTICAL APPLICATIONS	069009/022
CRYSTALS	SHOCK LAYER SHATTERING OF WATER DROPS AND ICE CRYSTALS IN REENTRY	203843/059
CURING	MANUFACTURING METHODS FOR RAPIDLY CURING ADVANCED COMPOSITES	201787/039
CURRENT	AC LOSS AS A FUNCTION OF CURRENT AND EXTERNAL MAGNETIC FIELD IN COMMERCIAL NBTI SUPERCONDUCTORS	203798/026
CUTTING	EXPLORATORY DEVELOPMENT OF IMPROVED CUTTING TOOLS FOR TITANIUM	204104/016
CVD	HARDENED CVD ZINC SELENIDE FOR FLIR WINDOWS	204037/030
CYCLE	LOW CYCLE FATIGUE CRACK INITIATION STUDY IN RENE 95	204036/011
CYCLIZATION	SYNTHESIS OF QUINOZALINE POLYMERS BY INTERMOLECULAR CYCLIZATION	203882/053

DAMPING	THE ROLE OF TRANSIENT SPECTRUM AND DAMPING ANALYSIS IN ASSESSING THE STRENGTH OF POLYMERIC ADHESIVE METAL BONDING	203522/010
DEEP	CRACK PROPAGATION CHARACTERISTICS IN THREE DEEP HARDENABLE TITANIUM ALLOYS	204112/016
DEEP	RESEARCH ON DEEP HARDENING TITANIUM ALLOY FOR LARGE AIRFRAME STRUCTURAL MEMBERS	203925/017
DEFECTS	EFFECT OF BEARING DEFECTS	200652/035
DEFINITION	EXPLORATORY DEVELOPMENT OF WELD QUALITY DEFINITION	203801/068
DEFORMATION	DEFORMATION MODE OF VOID-GROWTH AND COALESCENCE IN THE PROCESS OF DUCTILE FRACTURE	203896/017
DEFORMATION	NONLINEAR DEFORMATION OF GRAPHITIC MATERIALS	203565/066
DEFORMATION	DOASIS A COMPUTER CODE FOR THE DEFORMATION PLASTIC ORTHOTROPIC AXISYMMETRIC AND PLANE SOLUTION OF INELASTIC SOLIDS	204136/070
DEGRADATION	DATA ACQUISITION AND ANALYSIS OF LONG-TERM THERMO-AGING DEGRADATION DATA	203762/001
DEMONSTRATION	THE DEVELOPMENT AND DEMONSTRATION OF A HIGH TEMPERATURE RING TEST FACILITY	203415/066
DENSIFICATION	MANUFACTURING PROCESS FOR THE DENSIFICATION OF COMPLEX SHAPED WOVEN COMPOSITE PREFORMS	203848/037
DEPENDENT	EXPERIMENTAL HYSTERETIC LOSS FOR A SERIES OF SUPERCONDUCTING FILAMENTARY NbTi WIRES AND A FIELD DEPENDENT CRITICAL STATE MODEL	204035/024
DEPLETED	MANUFACTURING METHODS FOR 30MM DEPLETED URANIUM PENETRATORS	203449/033
DEPOSITION	CHEMICAL VAPOR DEPOSITION OF CHALCOGENIDE SEMICONDUCTORS	204098/029
DEPOSITION	CHEMICAL VAPOR DEPOSITION OF CADMIUM TELLURIDE	203682/028
DEPOSITION	CHEMICAL VAPOR DEPOSITION OF MULTISPECTRAL DOPES	203805/026



DERIVATIVES	POLYFUNCTIONAL FLUOROCARBON DERIVATIVES FOR CHEMICAL RESISTANT ELASTOMERS AND CROSSLINKING SYSTEMS	203535/050
DESIGN	DETERMINATION OF SELECTED MIL-HDBK-5 DESIGN ALLOWABLE PROPERTIES FOR FIVE AEROSPACE MATERIALS	203806/071
DESK	SOME GENERAL PROGRAMS FOR DESK TOP COMPUTERS	203811/009
DESPUN	INVESTIGATION OF CAGE AND BEARING INSTABILITY IN DESPUN ANTENNA BEARINGS DUE TO CHANGES IN LUBRICANT PROPERTIES	203888/055
DETECTOR	PYROELECTRIC FILM/LIQUID CRYSTAL DETECTOR FOR 10.6 UM REGION	203442/022
DEUTERIUM	MAGNETIC RELAXATION EFFECTS IN PRC05 AND SMXND1-XC05 INDUCED BY HYDROGEN AND DEUTERIUM	203569/023
DEV	EX DEV OF HYPERSONIC HEAT TRANSFER AND THERMOCHEMICAL ABLATION OF ADV MATLS NOSETIP TEST DATA EVAL AND ROUGH WALL TRANSITION	203847/069
DIELECTRIC	MANUFACTURING METHODS TO PRODUCE HIGH DIELECTRIC CONSTANT MATERIALS FOR MICROWAVE APPLICATIONS	204101/038
DIFFUSION	NONDESTRUCTIVE TESTING OF DIFFUSION BONDED TITANIUM ALLOYS FOR ENGINE AND AIRFRAME COMPONENTS	203842/006
DIODES	MANUFACTURING METHODS PROGRAM IMPATT DIODES	203727/034
DIRECTIONAL	AUTOMATED DIRECTIONAL SOLIDIFICATION OF SUPERALLOYS	204102/040
DISPLACEMENTS	A PRELIMINARY STUDY OF FATIGUE CRACK RETARDATION USING LASER INTERFEROMETRY TO MEASURE CRACK SURFACE DISPLACEMENTS	203807/005
DISPLAY	DEVELOPMENT OF LIQUID CRYSTAL SYSTEMS FOR AIR FORCE DISPLAY APPLICATIONS	204093/027
DISPLAYS	MATERIALS AND TECHNOLOGY FOR NEW INFORMATION DISPLAYS	203699/029
DOASIS	DOASIS A COMPUTER CODE FOR THE DEFORMATION PLASTIC ORTHOTROPIC AXISYMMETRIC AND PLANE SOLUTION OF INELASTIC SOLIDS	204136/070

DOMAIN	EXPLORATORY DEVELOPMENT OF MAGNETIC BUBBLE DOMAIN MATERIAL FOR APPLICATION IN AIR FORCE SOLID STATE MASS MEMORY SYSTEMS	203799/035
DOMES	CHEMICAL VAPOR DEPOSITION OF MULTISPECTRAL DOMES	203805/026
DOPED	GROWTH OF DOPED AND UNDOPED SINGLE CRYSTAL LASER MATERIALS IN THE SYSTEM (MF2)XX(YF3)1-X	203787/027
D024	RESULTS OF THE POLYMERIC FILMS SKYLAB D024 EXPERIMENT	203900/063
D024	SKYLAB D024 THERMAL CONTROL COATINGS AND POLYMERIC FILMS EXPERIMENT	203823/059
DRILLING	LASER DRILLING	203855/036
DROPS	SHOCK LAYER SHATTERING OF WATER DROPS AND ICE CRYSTALS IN REENTRY	203843/059
DROP/ROW	WATER DROP/ROW SHOCK INTERACTIONS	204094/018
DUCTILE	DEFORMATION MODE OF VOID-GROWTH AND COALESCENCE IN THE PROCESS OF DUCTILE FRACTURE	203896/017
DURABILITY	DEVELOPMENT OF POLYESTER/WOOL UNIFORM FABRIC WITH IMPROVED DURABILITY AND APPEARANCE	204039/061
DURABILITY	DURABILITY OF ADHESIVE BONDED JOINTS	203456/068
DYNAMIC	DYNAMIC COMPRESSIVE STRAIN RATE TESTS ON SEVERAL GRADES OF BERYLLIUM	203344/006
DYNAMIC	STATIC AND DYNAMIC FRACTURE PROPERTIES FOR ALUMINUM ALLOY 7475-T651 AND T7351	203783/069
DYNAMICS	DYNAMICS AND STATIC EVALUATION OF EXPERIMENTAL FUEL TANK SEALANT MATERIALS	203892/051
ELASTIC	ELASTIC COMPLIANCES FOR ATJ-S GRAPHITE AND MOD 3A CARBON/CARBON	203341/067
ELASTOMERIC	NEW ELASTOMERIC POLYMERS AND SPECIALTY CHEMICALS	203883/060
ELASTOMERIC	LONG LIFE ELASTOMERIC AIRCRAFT HYDRAULIC SEALS	203217/044
ELASTOMERS	POLYFUNCTIONAL FLUOROCARBON DERIVATIVES FOR CHEMICAL RESISTANT ELASTOMERS AND CROSSLINKING SYSTEMS	203535/050

ELASTOMERS	HIGH TEMPERATURE RESISTANT ELASTOMERS OR COMPLIANT POLYMERS	203297/042
ELECTRICAL	THERMAL ELECTRICAL AND PHYSICAL PROPERTY MEASUREMENTS OF LASER WINDOW MATERIALS	201819/026
EMBRITTLEMENT	STRESS-CORROSION CRACKING OF METALLIC MATERIALS PT III HYDROGEN ENTRY AND EMBRITTLEMENT IN STEEL	203562/014
EMISSION	MANUFACTURING METHODS FOR LOW EMISSION GRID COATINGS FOR BARIUM ACTIVATED CATHODE VACUUM TUBES	203455/033
ENGINE	MANUFACTURING METHODS FOR ENGINE BLADE REPAIR	201540/034
ENGINE	NONDESTRUCTIVE TESTING OF DIFFUSION BONDED TITANIUM ALLOYS FOR ENGINE AND AIRFRAME COMPONENTS	203842/006
ENGINE	DEVELOPMENT OF A GAS TURBINE ENGINE OIL FOR GULK OIL TEMPERATURES OF -40 TO 465 F	203680/051
ENTRY	STRESS-CORROSION CRACKING OF METALLIC MATERIALS PT III HYDROGEN ENTRY AND EMBRITTLEMENT IN STEEL	203562/004
ENVIRONMENT	THERMAL RESPONSE OF WOVEN AND KNITTED FABRICS IN JP-4 FUEL FIRE ENVIRONMENT	204134/057
ENVIRONMENTAL	SOME EFFECTS OF ENVIRONMENTAL FACTORS ON THE PERFORMANCE OF COATINGS FOR HIGH POWER IN LASERS	203566/024
ENVIRONMENTS	THERMOSTRUCTURAL RESPONSE OF CARBON/CARBON MATERIALS UNDER HIGH HEAT FLUX ENVIRONMENTS	203623/065
EPOXY	CORROSION BEHAVIOR OF METAL FASTENERS IN GRAPHITE EPOXY COMPOSITES	203812/056
EQUIPMENT	PROCEEDINGS OF THE 1974 TRISERVICE CORROSION OF MILITARY EQUIPMENT CONFERENCE 29-31 OCTOBER 1974 VOL II SESSION IV THROUGH VII	204110/070
EQUIPMENT	DEVELOPMENT OF BEARING AND LUBRICANT TEST EQUIPMENT	203459/046
ERODING	ON THE SHAPE OF ERODING BODIES WITH APPLICATION TO BALLISTIC RANGE EROSION TESTS	204103/063
EROSION	ON THE SHAPE OF ERODING BODIES WITH APPLICATION TO BALLISTIC RANGE EROSION TESTS	204103/063



EROSION	HIGH TEMPERATURES STABLE SUBSONIC RAIN EROSION RESISTANT FLUOROELASTOMERS COATINGS DEVELOPMENT	203793/057
ETHER	MOLECULAR TAILORING OF FLUOROCARBON ETHER BIRENZOXAZOLE POLYMERS TO LOWER GLASS TRANSITION TEMPERATURES	204008/054
ETHER	SYNTHESIS OF PERFLUOROALIPHATIC ETHER MONOMERS	203901/062
EVAL	EX DEV OF HYPERSONIC HEAT TRANSFER AND THERMOCHEMICAL ABLATION OF ADV MATLS NOSETIP TEST DATA EVAL AND ROUGH WALL TRANSITION	203847/069
EX	EX OF STAT FATIGUE CHARA OF 0.063-INCH MILL-ANNEALED TI-6AL-4V SHEET AND 0.050-INCH HEAT TREATED 17-7 PH STEEL SHEET UNDER SIM F BY F LOADING	202168/008
EX	EX DEV OF HYPERSONIC HEAT TRANSFER AND THERMOCHEMICAL ABLATION OF ADV MATLS NOSETIP TEST DATA EVAL AND ROUGH WALL TRANSITION	203847/069
EXFOLIATION	EFFECTS OF PURITY AND PROCESSING ON THE EXFOLIATION CORROSION BEHAVIOR OF 7X75 ALUMINUM PLATE	203885/014
EXPANSION	MANUFACTURING METHODS FOR THERMAL EXPANSION MOLDING OF ADVANCED COMPOSITES AIRCRAFT STRUCTURE	203128/038
EXPERIMENTAL	EXPERIMENTAL HYSTERETIC LOSS FOR A SERIES OF SUPERCONDUCTING FILAMENTARY NBTI WIPES AND A FIELD DEPENDENT CRITICAL STATE MODEL	204035/024
EXPERIMENTAL	DYNAMICS AND STATIC EVALUATION OF EXPERIMENTAL FUEL TANK SEALANT MATERIALS	203892/051
EXPLORATORY	EXPLORATORY DEVELOPMENT OF TRANSPARENT CONDUCTOR MATERIALS	203497/025
EXPLORATORY	EXPLORATORY DEVELOPMENT OF MAGNETIC BUBBLE DOMAIN MATERIAL FOR APPLICATION IN AIR FORCE SOLID STATE MASS MEMORY SYSTEMS	203799/035
EXPLORATORY	EXPLORATORY DEVELOPMENT TO STUDY THE LONG-TERM EFFECTS OF RESORBABLE CERAMICS IN PRIMATES	204006/020
EXPLORATORY	EXPLORATORY DEVELOPMENT ON THE FEASIBILITY AND RECOMMENDATION FOR NOI OF IR WINDOWS	203345/022

EXPLORATORY	EXPLORATORY DEVELOPMENT OF IMPROVED CUTTING TOOLS FOR TITANIUM	204104/016
EXPLORATORY	EXPLORATORY DEVELOPMENT OF HYPERSONIC HEAT TRANSFER AND THERMOMECHANICAL ABLATION OF ADVANCED MATERIALS	203847/070
EXPLORATORY	EXPLORATORY DEVELOPMENT OF COATED FABRIC FOR FIREFIGHTERS PROTECTIVE CLOTHING	203891/059
EXPLORATORY	EXPLORATORY DEVELOPMENT OF WELD QUALITY DEFINITION	203801/068
EXPLORATORY	EXPLORATORY DEVELOPMENT TO OBTAIN THERMAL AND MECHANICAL CHARACTERIZATION DATA ON ADVANCED CARBON INSULATION	203760/071
EXTERNAL	AC LOSS AS A FUNCTION OF CURRENT AND EXTERNAL MAGNETIC FIELD IN COMMERCIAL NBTI SUPERCONDUCTORS	203798/026
FABRIC	EXPLORATORY DEVELOPMENT OF COATED FABRIC FOR FIREFIGHTERS PROTECTIVE CLOTHING	203891/059
FABRIC	DEVELOPMENT OF POLYESTER/WOOL UNIFORM FABRIC WITH IMPROVED DURABILITY AND APPEARANCE	204039/061
FABRICATION	MANUFACTURING METHODS FOR FABRICATION AND ASSEMBLY OF ADVANCED COMPOSITE PRIMARY AIRCRAFT STRUCTURE	202878/038
FABRICATION	ADVANCED ABLATIVE HEATSHIELDS FOR REENTRY MISSILES PT I LOW RECESSION/HIGH STRENGTH PIQ MATRIX FABRICATION STUDY	204009/052
FABRICS	THERMAL RESPONSE OF WOVEN AND KNITTED FABRICS IN JP-4 FUEL FIRE ENVIRONMENT	204134/057
FAILURE	EFFECT OF PLASTIC PRESTRAIN ON THE TENSILE STRAIN TO FAILURE OF BERYLLIUM	203844/015
FASTENER	DETERMINATION OF STRESS INTENSITY FACTOR FOR COLD-WORKED FASTENER HOLES IN 7075 ALUMINUM USING THE CRACK GROWTH METHOD	203820/010
FASTENERS	CORROSION BEHAVIOR OF METAL FASTENERS IN GRAPHITE EPOXY COMPOSITES	203812/056

FATIGUE	LOW CYCLE FATIGUE CRACK INITIATION STUDY IN RENÉ 95	204036/011
FATIGUE	THE EFFECTS OF REST-TIME ON FATIGUE CRACK RETARDATION AND OBSERVATIONS	204059/015
FATIGUE	PROGRAM TO IMPROVE THE FRACTURE TOUGHNESS AND FATIGUE RESISTANCE OF ALUMINUM SHEET AND PLATE FOR AIRCRAFT APPLICATIONS	202045/004
FATIGUE	EX OF STAT FATIGUE CHARA OF 0.063-INCH MILL-ANNEALED TI-6AL-4V SHEET AND 0.050-INCH HEAT TREATED 17-7 PH STEEL SHEET UNDER SIM F BY F LOADING	202168/008
FATIGUE	A PRELIMINARY STUDY OF FATIGUE CRACK RETARDATION USING LASER INTERFEROMETRY TO MEASURE CRACK SURFACE DISPLACEMENTS	203807/005
FERRITES	MANUFACTURING METHODS FOR SPINEL FERRITES FOR USE IN MICROWAVE TUBES	203375/032
FIBER	MANUFACTURING METHODS FOR BBA FIBER	201112/036
FIBER	ADVANCED REENTRY MISSILE HEATSHIELD MATERIALS PART III: HIGH STRAIN/STRENGTH FIBER MULTIDIRECTIONAL REINFORCED THERMALLY STABLE MATRIX COMPONENTS	203294/043
FIBERS	GRAPHITE FIBERS FROM PITCH PT III	204004/045
FIBERS	GRAPHITE FIBERS FROM PITCH PT II	203205/045
FIBER/EPOXY	ACCELERATED CHARACTERIZATION OF FIBER/EPOXY COMPOSITES PT I VISCOELASTIC METHODS	203433/052
FIELD	EXPERIMENTAL HYSTERETIC LOSS FOR A SERIES OF SUPERCONDUCTING FILAMENTARY NBTI WIRES AND A FIELD DEPENDENT CRITICAL STATE MODEL	204035/024
FIELD	AC LOSS AS A FUNCTION OF CURRENT AND EXTERNAL MAGNETIC FIELD IN COMMERCIAL NBTI SUPERCONDUCTORS	203798/026
FILAMENT	LOW COST BORON FILAMENT	203853/036
FILAMENTARY	EXPERIMENTAL HYSTERETIC LOSS FOR A SERIES OF SUPERCONDUCTING FILAMENTARY NBTI WIRES AND A FIELD DEPENDENT CRITICAL STATE MODEL	204035/024



FILMS	PROTECTIVE-ANTIREFLECTIVE THIN FILMS FOR POLYCRYSTALLINE ZINC SELENIDE AND ALKALI HALIDE LASER WINDOWS	203173/025
FILMS	INFRARED TRANSPARENT POLYMERIC FILMS	203794/057
FILMS	RESULTS OF THE POLYMERIC FILMS SKYLAB 0024 EXPERIMENT	203900/063
FILMS	SKYLAB 0024 THERMAL CONTROL COATINGS AND POLYMERIC FILMS EXPERIMENT	203823/059
FILMS	APPARATUS AND TECHNIQUES USED FOR CASTING FILMS OF AROMATIC HETEROCYCLIC POLYMERS	203572/052
FILM/LIQUID	PYROELECTRIC FILM/LIQUID CRYSTAL DETECTOR FOR 10.6 UM REGION	203442/022
FIRE	THERMAL RESPONSE OF WOVEN AND KNITTED FABRICS IN JP-4 FUEL FIRE ENVIRONMENT	204134/057
FIREFIGHTERS	EXPLORATORY DEVELOPMENT OF COATED FABRIC FOR FIREFIGHTERS PROTECTIVE CLOTHING	203891/059
FIVE	DETERMINATION OF SELECTED MIL-HDBK-5 DESIGN ALLOWABLE PROPERTIES FOR FIVE AEROSPACE MATERIALS	203806/071
FLASH	THERMAL FLASH RESISTANT IR SUPPRESSION COATINGS FOR ADVANCED AIRCRAFT SYSTEMS	203750/050
FLATBOTTOM	ADAPTIVE NONLINEAR SIGNAL PROCESSING FOR CHARACTERIZATION OF ULTRASONIC NDE WAVEFORMS TASK I INFERENCE OF FLATBOTTOM HOLE SIZE	203736/012
FLAWS	A STRESS INTENSITY FACTOR CALIBRATION FOR CORNER FLAWS AT AN OPEN HOLE	203819/010
FLIR	HARDENED CVD ZINC SELENIDE FOR FLIR WINDOWS	204037/030
FLOW	BOUNDARY LAYER TRANSITION ON BLUNT BODIES IN HYPERSONIC FLOW	203628/075
FLOW	A STUDY OF THE UNSTEADY FLOW OVER CONCAVE CONIC MODELS AT MACH 15	204113/074
FLOW	THE STUDY OF THE EFFECT OF SCHOCK INTERACTION ON AXISYMMETRIC CONCAVE CONIC SHAPES IN HYPERSONIC FLOW	204109/074

FLUIDS	DEVELOPMENT OF HIGH TEMPERATURE FUNCTIONAL FLUIDS	203295/143
FLUIDS	FLUIDS LUBRICANTS FUELS AND RELATED MATERIALS	203484/149
FLUORIDE	FLUORIDE WINDOW MATERIALS FOR USE AS LASER WINDOWS IN THE 2 TO 6 UM SPECTRAL REGION	203598/128
FLUOROCARBON	MOLECULAR TAILORING OF FLUOROCARBON ETHER BIREFRACTING POLYMERS TO LOWER GLASS TRANSITION TEMPERATURES	204008/054
FLUOROCARBON	POLYFUNCTIONAL FLUOROCARBON DERIVATIVES FOR CHEMICAL RESISTANT ELASTOMERS AND CROSSLINKING SYSTEMS	203535/050
FLUOROELASTOMER	HIGH TEMPERATURES STABLE SUBSONIC RAIN EROSION RESISTANT FLUOROELASTOMERS COATINGS DEVELOPMENT	203793/157
FLUROSILICONES	HYBRID FLUROSILICONES FOR AIRCRAFT FUEL TANK SEALANTS	203981/041
FLUX	THERMOSTRUCTURAL RESPONSE OF CARBON/CARBON MATERIALS UNDER HIGH HEAT FLUX ENVIRONMENTS	203623/065
FORCE	DEVELOPMENT OF LIQUID CRYSTAL SYSTEMS FOR AIR FORCE DISPLAY APPLICATIONS	204093/027
FORCE	EXPLORATORY DEVELOPMENT OF MAGNETIC BUBBLE DOMAIN MATERIAL FOR APPLICATION IN AIR FORCE SOLID STATE MASS MEMORY SYSTEMS	203799/015
FORCE	ABSTRACTS OF ACTIVE CONTRACTS AIR FORCE MATERIALS LABORATORY	204023/001
FORCE/INDUSTRY	SUMMARY REPORT ON THE AIR FORCE/INDUSTRY COST REDUCTION PROGRAM RADAR PANEL PHASE II	204123/040
FORGING	HOT ISOSTATIC PRESSING OF Ti-6AL-4V POWDER FORGING PREFORMS	202196/034
FORMING	SUPERPLASTIC FORMING OF TITANIUM STRUCTURES	203854/037
FOURTH	PROCEEDINGS OF THE FOURTH ANNUAL CONFERENCE ON INFRARED LASER WINDOW	204097/028
FRACTOGRAPHY	SEM/TEM FRACTOGRAPHY HANDBOOK	REF263/076

FRACTURE	PROGRAM TO IMPROVE THE FRACTURE TOUGHNESS AND FATIGUE RESISTANCE OF ALUMINUM SHEET AND PLATE FOR AIRCRAFT APPLICATIONS	202045/004
FRACTURE	FRACTURE TOUGHNESS AGING BEHAVIOR GRAIN GROWTH AND HARDNESS OF ALPHA-BETA TITANIUM ALLOYS	202433/004
FRACTURE	DEFORMATION MODE OF VOID-GROWTH AND COALESCENCE IN THE PROCESS OF DUCTILE FRACTURE	203896/017
FRACTURE	FRACTURE TOUGHNESS AND AGING BEHAVIOR OF ALPHA-BETA TITANIUM ALLOYS	204092/017
FRACTURE	A STUDY OF FRACTURE MECHANICS FOR GRAPHITIC MATERIALS	203997/073
FRACTURE	STATIC AND DYNAMIC FRACTURE PROPERTIES FOR ALUMINUM ALLOY 7475-T651 AND T7351	203783/069
FRACTURE	BIAXIAL TENSILE FRACTURE OF ATJ-S GRAPHITE	203720/066
FUEL	THERMAL RESPONSE OF WOVEN AND KNITTED FABRICS IN JP-4 FUEL FIRE ENVIRONMENT	204134/057
FUEL	DYNAMICS AND STATIC EVALUATION OF EXPERIMENTAL FUEL TANK SEALANT MATERIALS	203892/051
FUEL	HYBRID FLUOROSILICONES FOR AIRCRAFT FUEL TANK SEALANTS	203981/041
FUELS	FLUIDS LUBRICANTS FUELS AND RELATED MATERIALS	203484/049
FUNCTION	AC LOSS AS A FUNCTION OF CURRENT AND EXTERNAL MAGNETIC FIELD IN COMMERCIAL NBTI SUPERCONDUCTORS	203798/026
FUNCTIONAL	DEVELOPMENT OF HIGH TEMPERATURE FUNCTIONAL FLUIDS	203295/043
F-15	F-15 COMPOSITE WING VOL II DEVELOPMENT AND TEST RESULTS	069613/002
F-15	F-15 COMPOSITE WING VOL I DEVELOPMENT AND TEST RESULTS	069613/002
GALLIUM	DEVELOPMENT OF GALLIUM ARSENIDE FOR INFRARED WINDOWS	203821/027



GALLIUM	ZINC ION IMPLANTATION OF SULFUR-DOPED GALLIUM PHOSPHIDE	203626/029
GAS	COMPUTER ANALYSIS OF THE MASS SPECTRA OF GAS MIXTURES	203356/047
GAS	DEVELOPMENT OF A GAS TURBINE ENGINE OIL FOR RULK OIL TEMPERATURES OF -40 TO 465 F	203680/051
GLASS	MOLECULAR TAILORING OF FLUOROCARBON ETHER BIBENZOXAZOLE POLYMERS TO LOWER GLASS TRANSITION TEMPERATURES	204008/054
GRADES	MECHANICAL PROPERTIES OF STRUCTURAL GRADES OF BERYLLIUM AT HIGH STRAIN RATES	204099/020
GRADES	DYNAMIC COMPRESSIVE STRAIN RATE TESTS ON SEVERAL GRADES OF BERYLLIUM	203344/006
GRADES	NOTCH TENSILE STRENGTH OF ADVANCED STRUCTURAL GRADES OF BERYLLIUM	203675/007
GRAIN	GRAIN REFINEMENT OF TITANIUM ALLOYS	203457/008
GRAIN	FRACTURE TOUGHNESS AGING BEHAVIOR GRAIN GROWTH AND HARDNESS OF ALPHA-BETA TITANIUM ALLOYS	202433/004
GRAPHITE	ANALYSIS OF HIGH STRAIN GRAPHITE	203438/065
GRAPHITE	ELASTIC COMPLIANCES FOR ATJ-S GRAPHITE AND MOD 3A CARBON/CARBON	203341/067
GRAPHITE	BIAXIAL TENSILE FRACTURE OF ATJ-S GRAPHITE	203720/066
GRAPHITE	CORROSION BEHAVIOR OF METAL FASTENERS IN GRAPHITE EPOXY COMPOSITES	203812/056
GRAPHITE	GRAPHITE FIBERS FROM PITCH PT III	204004/045
GRAPHITE	MATERIALS VARIABLES AFFECTING THE IMPACT RESISTANCE OF GRAPHITE AND BORON COMPOSITES	203306/048
GRAPHITE	MATERIALS VARIABLES AFFECTING THE IMPACT RESISTANCE OF GRAPHITE AND BORON COMPOSITES PART II	203894/048
GRAPHITE	IMPROVED ATJS GRAPHITE PT I MATERIALS AND PROCESS STUDIES	203347/047

GRAPHITE	GRAPHITE FIBERS FROM PITCH PT II	203205/045
GRAPHITIC	A STUDY OF FRACTURE MECHANICS FOR GRAPHITIC MATERIALS	203997/073
GRAPHITIC	NONLINEAR DEFORMATION OF GRAPHITIC MATERIALS	203565/066
GREASE	GREASE LUBRICATION OF HELICOPTER TRANSMISSIONS	203846/055
GREASE	POLYFLUOROALKYL-ALKYL POLYSILOXANE GREASE FOR INSTRUMENT LUBRICATION	203351/053
GREASES	PERFORMANCE OF LUBRICANTS OILS AND GREASES IN WEAR TESTS AND COMPACT MATERIALS IN BALL BEARINGS	203570/055
GREASES	HIGH TEMPERATURE THERMALLY STABLE GREASES	203409/042
GRID	MANUFACTURING METHODS FOR LOW EMISSION GRID COATINGS FOR BARIUM ACTIVATED CATHODE VACUUM TUBES	203455/033
GROWTH	GROWTH OF DOPED AND UNDOPED SINGLE CRYSTAL LASER MATERIALS IN THE SYSTEM (MF2)XX(YF3)1-X	203787/027
GROWTH	DETERMINATION OF STRESS INTENSITY FACTOR FOR COLD-WORKED FASTENER HOLES IN 7075 ALUMINUM USING THE CRACK GROWTH METHOD	203820/010
GROWTH	FRACTURE TOUGHNESS AGING BEHAVIOR GRAIN GROWTH AND HARDNESS OF ALPHA-BETA TITANIUM ALLOYS	202433/004
GROWTH	GROWTH OF MULTICOMPONENT COMPOSITES FROM THE MELT	203880/012
HALIDE	HALIDE MATERIAL PROCESSING FOR HIGH-POWER INFRARED LASER WINDOWS	203994/030
HALIDE	PROTECTIVE-ANTIREFLECTIVE THIN FILMS FOR POLYCRYSTALLINE ZINC SELENIDE AND ALKALI HALIDE LASER WINDOWS	203173/025
HANDBOOK	SEM/TEM FRACTOGRAPHY HANDBOOK	REF263/076
HANDBOOK	ADHESIVE BONDED AEROSPACE STRUCTURES STANDARDIZED REPAIR HANDBOOK	203983/075
HARDENABLE	CRACK PROPAGATION CHARACTERISTICS IN THREE DEEP HARDENABLE TITANIUM ALLOYS	204112/016

HARDENED	HARDENED CVD ZINC SELENIDE FOR FLIR WINDOWS	204037/030
HARDENING	RESEARCH ON DEEP HARDENING TITANIUM ALLOY FOR LARGE AIRFRAME STRUCTURAL MEMBERS	203925/013
HARDNESS	FRACTURE TOUGHNESS AGING BEHAVIOR GRAIN GROWTH AND HARDNESS OF ALPHA-BETA TITANIUM ALLOYS	202433/004
HEAT	EX OF STAT FATIGUE CHARA OF 0.063-INCH MILL-ANNEALED TI-6AL-4V SHEET AND 0.050-INCH HEAT TREATED 17-7 PH STEEL SHEET UNDER SIM F BY F LOADING	202168/008
HEAT	THERMOSTRUCTURAL RESPONSE OF CARBON/CARBON MATERIALS UNDER HIGH HEAT FLUX ENVIRONMENTS	203623/065
HEAT	EXPLORATORY DEVELOPMENT OF HYPERSONIC HEAT TRANSFER AND THERMOMECHANICAL ABLATION OF ADVANCED MATERIALS	203847/070
HEAT	EX DEV OF HYPERSONIC HEAT TRANSFER AND THERMOCHEMICAL ABLATION OF ADV MATLS NOSETIP TEST DATA EVAL AND ROUGH WALL TRANSITION	203847/069
HEATING	OXIDATION BEHAVIOR OF TITANIUM ALLOYS UNDER HIGH HEATING RATES	203776/008
HEATING	RADIANT HEATING OF AEROSPACE MATERIALS PT II LASER EFFECTS PREDICTION PROCEDURE COME	204003/046
HEATSHIELD	ADVANCED REENTRY MISSILE HEATSHIELD MATERIALS PART III: HIGH STRAIN/STRENGTH FIBER MULTIDIRECTIONAL REINFORCED THERMALLY STABLE MATRIX COMPONENTS	203294/043
HEATSHIELDS	ADVANCED ABLATIVE HEATSHIELDS FOR REENTRY MISSILES PT I LOW RECESSION/HIGH STRENGTH PIQ MATRIX FABRICATION STUDY	204009/052
HELICOPTER	GREASE LUBRICATION OF HELICOPTER TRANSMISSIONS	203846/055
HETEROCYCLIC	APPARATUS AND TECHNIQUES USED FOR CASTING FILMS OF AROMATIC HETEROCYCLIC POLYMERS	203572/052
HIGH-POWER	HALIDE MATERIAL PROCESSING FOR HIGH-POWER INFRARED LASER WINDOWS	203994/030



HOLE	ADAPTIVE NONLINEAR SIGNAL PROCESSING FOR CHARACTERIZATION OF ULTRASONIC NOE WAVEFORMS TASK I INFERENCE OF FLATBOTTOM HOLE SIZE	203736/012
HOLE	A STRESS INTENSITY FACTOR CALIBRATION FOR CORNER FLAWS AT AN OPEN HOLE	203819/010
HOLES	DETERMINATION OF STRESS INTENSITY FACTOR FOR COLD-WORKED FASTENER HOLES IN 7075 ALUMINUM USING THE CRACK GROWTH METHOD	203820/010
HOPKINSON	INSTRUMENTED IMPACT TESTING USING A HOPKINSON BAR APPARATUS	203822/015
HOT	HOT ISOSTATIC PRESSING OF TI-6AL-4V POWDER FORGING PREFORMS	202196/034
HOT	DEVELOPMENT OF HOT ISOSTATIC PRESSING TECHNIQUES FOR PRODUCING HIGH QUALITY RILLET FROM TITANIUM ALLOY POWDER	203881/012
HYBRID	BORON ALUMINUM TITANIUM HYBRID COMPOSITES	203824/007
HYBRID	HYBRID FLUROSILICONES FOR AIRCRAFT FUEL TANK SEALANTS	203981/041
HYDRAULIC	LONG LIFE ELASTOMERIC AIRCRAFT HYDRAULIC SEALS	203217/044
HYDROFLUOROCARB	HYDROFLUOROCARBON SEALANTS WITH IMPROVED LOW TEMPERATURE AND STRESS CORROSION PROPERTIES	203359/044
HYDROGEN	MAGNETIC RELAXATION EFFECTS IN PRC05 AND SMXND1-XC05 INDUCED BY HYDROGEN AND DEUTERIUM	203569/023
HYDROGEN	STRESS-CORROSION CRACKING OF METALLIC MATERIALS PT III HYDROGEN ENTRY AND EMBRITTLEMENT IN STEEL	203562/004
HYPERSONIC	EXPLORATORY DEVELOPMENT OF HYPERSONIC HEAT TRANSFER AND THERMOMECHANICAL ABLATION OF ADVANCED MATERIALS	203847/070
HYPERSONIC	EX DEV OF HYPERSONIC HEAT TRANSFER AND THERMOCHEMICAL ABLATION OF ADV MATLS NOSETIP TEST DATA EVAL AND ROUGH WALL TRANSITION	203847/069
HYPERSONIC	BOUNDARY LAYER TRANSITION ON BLUNT BODIES IN HYPERSONIC FLOW	203628/075

HYPERSONIC	THE STUDY OF THE EFFECT OF SHOCK INTERACTION ON AXISYMMETRIC CONCAVE CONIC SHAPES IN HYPERSONIC FLOW	204109/074
HYSTERETIC	EXPERIMENTAL HYSTERETIC LOSS FOR A SERIES OF SUPERCONDUCTING FILAMENTARY NbTi WIRES AND A FIELD DEPENDENT CRITICAL STATE MODEL	204035/024
ICE	SHOCK LAYER SHATTERING OF WATER DROPS AND ICE CRYSTALS IN REENTRY	203843/059
III	ADVANCED REENTRY MISSILE HEATSHIELD MATERIALS PART III: HIGH STRAIN/STRENGTH FIBER MULTIDIRECTIONAL REINFORCED THERMALLY STABLE MATRIX COMPONENTS	203294/043
II-VI	ROOM TEMPERATURE INJECTION LUMINESCENCE IN II-VI SEMICONDUCTORS	201818/023
ILL-POSED	INFERRING MECHANICAL RELAXATION SPECTRA AN ILL-POSED PROBLEM	203851/051
IMPACT	INSTRUMENTED IMPACT TESTING USING A HOPKINSON BAR APPARATUS	203822/015
IMPACT	MATERIALS VARIABLES AFFECTING THE IMPACT RESISTANCE OF GRAPHITE AND BORON COMPOSITES PART II	203894/048
IMPACT	MATERIALS VARIABLES AFFECTING THE IMPACT RESISTANCE OF GRAPHITE AND BORON COMPOSITES	203306/048
IMPATT	MANUFACTURING METHODS PROGRAM IMPATT DIODES	203727/034
IMPLANTATION	ZINC ION IMPLANTATION OF SULFUR-DOPED GALLIUM PHOSPHIDE	203626/029
INDUCED	MAGNETIC RELAXATION EFFECTS IN PZC05 AND SMXN01-XC05 INDUCED BY HYDROGEN AND DEUTERIUM	203569/023
INELASTIC	DOASIS A COMPUTER CODE FOR THE DEFORMATION PLASTIC ORTHOTROPIC AXISYMMETRIC AND PLANE SOLUTION OF INELASTIC SOLIDS	204136/070
INFERENCE	ADAPTIVE NONLINEAR SIGNAL PROCESSING FOR CHARACTERIZATION OF ULTRASONIC NDE WAVEFORMS TASK I INFERENCE OF FLATBOTTOM HOLE SIZE	203736/012

INFERRING	INFERRING MECHANICAL RELAXATION SPECTRA AN ILL-POSED PROBLEM	203851/051
INFRARED	DEVELOPMENT OF GALLIUM ARSENIDE FOR INFRARED WINDOWS	203821/027
INFRARED	HALIDE MATERIAL PROCESSING FOR HIGH-POWER INFRARED LASER WINDOWS	203994/030
INFRARED	PROCEEDINGS OF THE FOURTH ANNUAL CONFERENCE ON INFRARED LASER WINDOW	204097/028
INFRARED	INFRARED TRANSPARENT POLYMERIC FILMS	203794/057
INHIBITIVE	MATERIALS AND APPROACHES FOR IMPROVED STRESS CORROSION INHIBITIVE COATINGS	203218/043
INITIATION	LOW CYCLE FATIGUE CRACK INITIATION STUDY IN PENE 95	204036/011
INJECTION	ROOM TEMPERATURE INJECTION LUMINESCENCE IN II-VI SEMICONDUCTORS	201818/023
INSTABILITY	INVESTIGATION OF CAGE AND BEARING INSTABILITY IN DESPUN ANTENNA BEARINGS DUE TO CHANGES IN LUBRICANT PROPERTIES	203888/055
INSTRUMENT	POLYFLUOROALKYL-ALKYL POLYSTILOXANE GREASE FOR INSTRUMENT LUBRICATION	203351/053
INSTRUMENTED	INSTRUMENTED IMPACT TESTING USING A HOPKINSON BAR APPARATUS	203822/015
INSULATION	EXPLORATORY DEVELOPMENT TO OBTAIN THERMAL AND MECHANICAL CHAPACTERIZATION DATA ON ADVANCED CARBON INSULATION	203760/071
INSULATOR	IMPROVED INSULATOR MATERIALS REQUIREMENT PROGRAM	203389/065
INTENSE	AEROSPACE MATERIALS RESPONSE TO INTENSE THERMAL RADIATION	204108/060
INTENSITY	TWO-DIMENSIONAL STRESS INTENSITY FACTOR SOLUTIONS FOR RADially CRACKED RINGS	204057/018
INTENSITY	DETERMINATION OF STRESS INTENSITY FACTOR FOR COLD-WORKED FASTENER HOLES IN 7075 ALUMINUM USING THE CRACK GROWTH METHOD	203820/010



INTENSITY	A STRESS INTENSITY FACTOR CALIBRATION FOR CORNER FLAWS AT AN OPEN HOLE	203819/010
INTERACTION	THE STUDY OF THE EFFECT OF SCHOCK INTERACTION ON AXISYMMETRIC CONCAVE CONIC SHAPES IN HYPERSONIC FLOW	204109/074
INTERACTIONS	WATER DROP/BOW SHOCK INTERACTIONS	204094/018
INTERFEROMETRY	A PRELIMINARY STUDY OF FATIGUE CRACK RETARDATION USING LASER INTERFEROMETRY TO MEASURE CRACK SURFACE DISPLACEMENTS	203807/015
INTERMOLECULAR	SYNTHESIS OF QUINOZALINE POLYMERS BY INTERMOLECULAR CYCLIZATION	203882/053
ION	ZINC ION IMPLANTATION OF SULFUR-DOPED GALLIUM PHOSPHIDE	203626/029
IR	EXPLORATORY DEVELOPMENT ON THE FEASIBILITY AND RECOMMENDATION FOR NOI OF IR WINDOWS	203345/022
IR	THERMAL FLASH RESISTANT IR SUPPRESSION COATINGS FOR ADVANCED AIRCRAFT SYSTEMS	203750/050
IRON	INFLUENCE OF IRON AND SILICON CONTENT ON THE TENSILE PROPERTIES OF 7X75 AND ZR-MOLDED 7X75 ALUMINUM PLATE	204007/019
ISOSTATIC	HOT ISOSTATIC PRESSING OF TI-6AL-4V POWDER FORGING PREFORMS	202195/034
ISOSTATIC	DEVELOPMENT OF HOT ISOSTATIC PRESSING TECHNIQUES FOR PRODUCING HIGH QUALITY BILLET FROM TITANIUM ALLOY POWDER	203881/012
IV	PROCEEDINGS OF THE 1974 TRISERVICE CORROSION OF MILITARY EQUIPMENT CONFERENCE 29-31 OCTOBER 1974 VOL II SESSION IV THROUGH VII	204110/070
IV	POLYMER STRUCTURES AND PROPERTIES PART IV THERMALLY STABLE POLYMERS	203895/041
JANUARY	ABSTRACTS OF AF MATERIALS LABORATORY REPORTS JANUARY 1974-DECEMBER 1974	204111/001
JOINTS	DURABILITY OF ADHESIVE BONDED JOINTS	203456/058

JP-4	THERMAL RESPONSE OF WOVEN AND KNITTED FABRICS IN JP-4 FUEL FIRE ENVIRONMENT	204134/057
KNITTED	THERMAL RESPONSE OF WOVEN AND KNITTED FABRICS IN JP-4 FUEL FIRE ENVIRONMENT	204134/057
LARGE	RESEARCH ON DEEP HARDENING TITANIUM ALLOY FOR LARGE AIRFRAME STRUCTURAL MEMBERS	203925/013
LARGE	PPQ ADHESIVES FOR LARGE AREA BONDING OF TITANIUM ALLOYS	204106/062
LARGE-AREA	LOW-TEMPERATURE LARGE-AREA BRAZING OF TITANIUM STRUCTURES	201790/014
LASER	PROCEEDINGS OF THE FOURTH ANNUAL CONFERENCE ON INFRARED LASER WINDOW	204097/028
LASER	LASER DRILLING	203855/036
LASER	PROTECTIVE-ANTIREFLECTIVE THIN FILMS FOR POLYCRYSTALLINE ZINC SELENIDE AND ALKALI HALIDE LASER WINDOWS	203173/025
LASER	PERFECTION OF GALASOAPIND LASER MATERIAL	203502/024
LASER	THERMAL ELECTRICAL AND PHYSICAL PROPERTY MEASUREMENTS OF LASER WINDOW MATERIALS	201819/026
LASER	HALIDE MATERIAL PROCESSING FOR HIGH-POWER INFRARED LASER WINDOWS	203994/030
LASER	GROWTH OF DOPED AND UNDOPED SINGLE CRYSTAL LASER MATERIALS IN THE SYSTEM (MF2)XX(YF3)1-X	203787/027
LASER	FLUORIDE WINDOW MATERIALS FOR USE AS LASER WINDOWS IN THE 2 TO 6 UM SPECTRAL REGION	203898/028
LASER	BASIC RESEARCH ON LASER PLUME CHARACTERIZATION	203714/009
LASER	A PRELIMINARY STUDY OF FATIGUE CRACK RETARDATION USING LASER INTERFEROMETRY TO MEASURE CRACK SURFACE DISPLACEMENTS	203807/035
LASER	RADIANT HEATING OF AEROSPACE MATERIALS PT II LASER EFFECTS PREDICTION PROCEDURE CODE	204003/046
LASERS	SOME EFFECTS OF ENVIRONMENTAL FACTORS ON THE PERFORMANCE OF COATINGS FOR HIGH POWER IN LASERS	203566/024

LAYER	SHOCK LAYER SHATTERING OF WATER DROPS AND ICE CRYSTALS IN REENTRY	203843/059
LAYER	BOUNDARY LAYER TRANSITION ON BLUNT BODIES IN HYPERSONIC FLOW	203628/075
LIFE	LIFE ASSURANCE OF COMPOSITE STRUCTURES VOL I MOISTURE EFFECTS	203825/007
LIFE	LONG LIFE ELASTOMERIC AIRCRAFT HYDRAULIC SEALS	203217/044
LIMITS	PRACTICAL SENSITIVITY LIMITS OF PRODUCTION NONDESTRUCTIVE TESTING METHODS IN ALUMINUM AND STEEL	203852/007
LINEAR	MODAL ANALYSIS OF LINEAR NON-CONSERVATIVE SYSTEMS	203774/011
LIQUID	DEVELOPMENT OF LIQUID CRYSTAL SYSTEMS FOR AIR FORCE DISPLAY APPLICATIONS	204093/027
LOADING	EX OF STAT FATIGUE CHARA OF 0.063-INCH MILL-ANNEALED TI-6AL-4V SHEET AND 0.050-INCH HEAT TREATED 17-7 PH STEEL SHEET UNDER SIM F BY F LOADING	202168/008
LONG-TERM	EXPLORATORY DEVELOPMENT TO STUDY THE LONG-TERM EFFECTS OF RESORBABLE CERAMICS IN PRIMATES	204006/020
LONG-TERM	DATA ACQUISITION AND ANALYSIS OF LONG-TERM THERMO-AGING DEGRADATION DATA	203762/001
LOSS	EXPERIMENTAL HYSTERETIC LOSS FOR A SERIES OF SUPERCONDUCTING FILAMENTARY NBTI WIRES AND A FIELD DEPENDENT CRITICAL STATE MODEL	204035/024
LOSS	AC LOSS AS A FUNCTION OF CURRENT AND EXTERNAL MAGNETIC FIELD IN COMMERCIAL NBTI SUPERCONDUCTORS	203799/026
LOW-TEMPERATURE	LOW-TEMPERATURE LARGE-AREA BRAZING OF TITANIUM STRUCTURES	201790/014
LUBRICANT	INVESTIGATION OF GAGE AND BEARING INSTABILITY IN DESPUN ANTENNA BEARINGS DUE TO CHANGES IN LUBRICANT PROPERTIES	203888/055
LUBRICANT	DETERMINATION OF CHANGES IN LUBRICANT VISCOSITIES AT HIGH PRESSURES AND TEMPERATURES	203255/047



LUBRICANT	DEVELOPMENT OF BEARING AND LUBRICANT TEST EQUIPMENT	203459/046
LUBRICANTS	PERFORMANCE OF LUBRICANTS OILS AND GREASES IN WEAR TESTS AND COMPACT MATERIALS IN BALL BEARINGS	203570/055
LUBRICANTS	FLUIDS LUBRICANTS FUELS AND RELATED MATERIALS	203484/049
LUBRICATION	GREASE LUBRICATION OF HELICOPTER TRANSMISSIONS	203846/055
LUBRICATION	POLYFLUOROALKYL-ALKYL POLYSILOXANE GREASE FOR INSTRUMENT LUBRICATION	203351/053
LUMINESCENCE	ROOM TEMPERATURE INJECTION LUMINESCENCE IN II-VI SEMICONDUCTORS	201818/023
MACH	A STUDY OF THE UNSTEADY FLOW OVER CONCAVE CONIC MODELS AT MACH 15	204113/074
MAGNETIC	EXPLORATORY DEVELOPMENT OF MAGNETIC BUBBLE DOMAIN MATERIAL FOR APPLICATION IN AIR FORCE SOLID STATE MASS MEMORY SYSTEMS	203799/035
MAGNETIC	AC LOSS AS A FUNCTION OF CURRENT AND EXTERNAL MAGNETIC FIELD IN COMMERCIAL NBTI SUPERCONDUCTORS	203798/026
MAGNETIC	MAGNETIC RELAXATION EFFECTS IN PRC05 AND SMXND1-XC05 INDUCED BY HYDROGEN AND DEUTERIUM	203569/023
MANUFACTURING	MANUFACTURING METHODS FOR BBB FIBER	201112/036
MANUFACTURING	PHASE SHIFTER MANUFACTURING METHODS	203286/031
MANUFACTURING	MANUFACTURING METHODS FOR SPINEL FERITES FOR USE IN MICROWAVE TUBES	203375/032
MANUFACTURING	MANUFACTURING METHODS FOR 30MM DEPLETED URANIUM PENETRATORS	203449/033
MANUFACTURING	PLATED WIRE MASS MEMORY ARRAY MANUFACTURING METHODS	203884/032
MANUFACTURING	MANUFACTURING METHODS FOR LOW EMISSION GRID COATINGS FOR BARIUM ACTIVATED CATHODE VACUUM TUBES	203455/033
MANUFACTURING	MANUFACTURING METHODS FOR ENGINE BLADE REPAIR	201540/034

MANUFACTURING	NOTCHING MACHINE MANUFACTURING METHODS	200988/033
MANUFACTURING	MANUFACTURING METHODS PROGRAM IMPATT DIODES	203727/034
MANUFACTURING	LOW COST MANUFACTURING CONCEPTS OF ADVANCED COMPOSITE PRIMARY AIRCRAFT	203059/039
MANUFACTURING	MANUFACTURING METHODS FOR RAPIDLY CURING ADVANCED COMPOSITES	201787/039
MANUFACTURING	MANUFACTURING METHODS TO PRODUCE HIGH DIELECTRIC CONSTANT MATERIALS FOR MICROWAVE APPLICATIONS	204101/038
MANUFACTURING	MANUFACTURING METHODS FOR FABRICATION AND ASSEMBLY OF ADVANCED COMPOSITE PRIMARY AIRCRAFT STRUCTURE	202878/038
MANUFACTURING	MANUFACTURING METHODS FOR THERMAL EXPANSION MOLDING OF ADVANCED COMPOSITES AIRCRAFT STRUCTURE	203128/038
MANUFACTURING	MANUFACTURING PROCESS FOR THE DENSIFICATION OF COMPLEX SHAPED WOVEN COMPOSITE PREFORMS	203848/037
MASS	EXPLORATORY DEVELOPMENT OF MAGNETIC BUBBLE DOMAIN MATERIAL FOR APPLICATION IN AIR FORCE SOLID STATE MASS MEMORY SYSTEMS	203799/035
MASS	PLATED WIRE MASS MEMORY ARRAY MANUFACTURING METHODS	203884/032
MASS	COMPUTER ANALYSIS OF THE MASS SPECTRA OF GAS MIXTURES	203356/047
MATLS	EX DEV OF HYPERSONIC HEAT TRANSFER AND THERMOCHEMICAL ABLATION OF ADV MATLS NOSETIP TEST DATA EVAL AND ROUGH WALL TRANSITION	203847/059
MATRIX	ADVANCED ABLATIVE HEATSHIELDS FOR REENTRY MISSILES PT I LOW RECESSION/HIGH STRENGTH PIO MATRIX FABRICATION STUDY	204009/052
MATRIX	ADVANCED REENTRY MISSILE HEATSHIELD MATERIALS PART III: HIGH STRAIN/STRENGTH FIBER MULTIDIRECTIONAL REINFORCED THERMALLY STABLE MATRIX COMPONENTS	203294/043
MECHANICAL	MECHANICAL PROPERTIES OF STRUCTURAL GRADES OF BERYLLIUM AT HIGH STRAIN RATES	204099/020

MECHANICAL	MICROSTRUCTURE MECHANICAL PROPERTY RELATIONSHIP IN SUPERALLOYS	204114/019
MECHANICAL	DEVELOPMENT OF ENGINEERING DATA ON THE MECHANICAL AND PHYSICAL PROPERTIES OF ADVANCED COMPOSITE MATERIALS	203772/067
MECHANICAL	EXPLORATORY DEVELOPMENT TO OBTAIN THERMAL AND MECHANICAL CHARACTERIZATION DATA ON ADVANCED CARBON INSULATION	203760/071
MECHANICAL	MECHANICAL PROPERTY DATA FOR ALUMINUM ALLOY 2419-T851 PLATE	204031/073
MECHANICAL	INFERRING MECHANICAL RELAXATION SPECTRA AN ILL-POSED PROBLEM	203851/051
MECHANICS	A STUDY OF FRACTURE MECHANICS FOR GRAPHITIC MATERIALS	203997/073
MELT	GROWTH OF MULTICOMPONENT COMPOSITES FROM THE MELT	203880/012
MELTING	NONCONSUMABLE MELTING OF TITANIUM	200710/037
MEMBERS	RESEARCH ON DEEP HARDENING TITANIUM ALLOY FOR LARGE AIRFRAME STRUCTURAL MEMBERS	203925/013
MEMORY	PLATED WIRE MASS MEMORY ARRAY MANUFACTURING METHODS	203884/032
MEMORY	EXPLORATORY DEVELOPMENT OF MAGNETIC BUBBLE DOMAIN MATERIAL FOR APPLICATION IN AIR FORCE SOLID STATE MASS MEMORY SYSTEMS	203799/035
METALLIC	STRESS-CORROSION CRACKING OF METALLIC MATERIALS PT III HYDROGEN ENTRY AND EMBRITTLEMENT IN STEEL	203562/004
MICROSTRUCTURAL	MICROSTRUCTURAL RELATIONSHIPS IN 2-2-3 CARBON REINFORCED CARBON COMPOSITES	204033/073
MICROSTRUCTURE	MICROSTRUCTURE MECHANICAL PROPERTY RELATIONSHIP IN SUPERALLOYS	204114/019
MICROWAVE	MANUFACTURING METHODS FOR SPINEL FERRITES FOR USE IN MICROWAVE TUBES	203375/032
MICROWAVE	MANUFACTURING METHODS TO PRODUCE HIGH DIELECTRIC CONSTANT MATERIALS FOR MICROWAVE APPLICATIONS	204101/038



MILITARY	PROCEEDINGS OF THE 1974 TRISERVICE CORROSION OF MILITARY EQUIPMENT CONFERENCE 29-31 OCTOBER 1974 VOL II SESSION IV THROUGH VII	204110/070
MILL-ANNEALED	EX OF STAT FATIGUE CHAPA OF 0.063-INCH MILL-ANNEALED TI-6AL-4V SHEET AND 0.050-INCH HEAT TREATED 17-7 PH STEEL SHEET UNDER SIM F BY F LOADING	202168/008
MIL-HDBK-5	DETERMINATION OF SELECTED MIL-HDBK-5 DESIGN ALLOWABLE PROPERTIES FOR FIVE AEROSPACE MATERIALS	203806/071
MISSILE	ADVANCED PROTECTIVE MATERIALS FOR REENTRY MISSILE NOSETIPS PT I THREE-DIMENSIONAL REINFORCED CARBON/PLASTIC COMPOSITES	203826/058
MISSILE	ADVANCED REENTRY MISSILE HEATSHIELD MATERIALS PART III: HIGH STRAIN/STRENGTH FIBER MULTIDIRECTIONAL REINFORCED THERMALLY STABLE MATRIX COMPONENTS	203294/043
MISSILES	ADVANCED ABLATIVE HEATSHIELDS FOR REENTRY MISSILES PT I LOW RECESSION/HIGH STRENGTH PTO MATRIX FABRICATION STUDY	204009/052
MIXTURES	COMPUTER ANALYSIS OF THE MASS SPECTRA OF GAS MIXTURES	203356/047
ML-101	ML-101 THERMAL CONTROL COATING SPACEFLIGHT EXPERIMENT	204133/054
MOD	ELASTIC COMPLIANCES FOR ATJ-S GRAPHITE AND MOD 3A CARBON/CARBON	203341/067
MODAL	MODAL ANALYSIS OF LINEAR NON-CONSERVATIVE SYSTEMS	203774/011
MODE	DEFORMATION MODE OF VOID-GROWTH AND COALESCENCE IN THE PROCESS OF DUCTILE FRACTURE	203896/017
MOISTURE	LIFE ASSURANCE OF COMPOSITE STRUCTURES VOL I MOISTURE EFFECTS	203825/002
MOLDING	MANUFACTURING METHODS FOR THERMAL EXPANSION MOLDING OF ADVANCED COMPOSITES AIRCRAFT STRUCTURE	203128/038

MOLECULAR	MOLECULAR TAILORING OF FLUOROCARBON ETHER BIBENZOXAZOLE POLYMERS TO LOWER GLASS TRANSITION TEMPERATURES	204008/054
MOLECULAR	SYNTHESIS OF HIGH MOLECULAR WEIGHT PARAPHENYLENE PBI	203337/048
MONOMERS	SYNTHESIS OF PERFLUOROALIPHATIC ETHER MONOMERS	203901/052
MULTICOMPONENT	GROWTH OF MULTICOMPONENT COMPOSITES FROM THE MELT	203880/012
MULTIDIRECTIONAL	ADVANCED REENTRY MISSILE HEATSHIELD MATERIALS PART III: HIGH STRAIN/STRENGTH FIBER MULTIDIRECTIONAL REINFORCED THERMALLY STABLE MATRIX COMPONENTS	203294/043
MULTISPECTRAL	CHEMICAL VAPOR DEPOSITION OF MULTISPECTRAL DOMES	203805/025
MW	THE CARBON/CARBON ASSESSMENT PROGRAM 50 MW ABLATION TESTING AND RESULTS	204048/055
NBTI	EXPERIMENTAL HYSTERETIC LOSS FOR A SERIES OF SUPERCONDUCTING FILAMENTARY NBTI WIPES AND A FIELD DEPENDENT CRITICAL STATE MODEL	204035/024
NBTI	AC LOSS AS A FUNCTION OF CURRENT AND EXTERNAL MAGNETIC FIELD IN COMMERCIAL NBTI SUPERCONDUCTORS	203798/026
NDE	ADAPTIVE NONLINEAR SIGNAL PROCESSING FOR CHARACTERIZATION OF ULTRASONIC NDE WAVEFORMS TASK I INFERENCE OF FLATBOTTOM HOLE SIZE	203736/012
NDI	EXPLORATORY DEVELOPMENT ON THE FEASIBILITY AND RECOMMENDATION FOR NDI OF IR WINDOWS	203345/022
NONCONSUMABLE	NONCONSUMABLE MELTING OF TITANIUM	200710/037
NONDESTRUCTIVE	PRACTICAL SENSITIVITY LIMITS OF PRODUCTION NONDESTRUCTIVE TESTING METHODS IN ALUMINUM AND STEEL	203852/007
NONDESTRUCTIVE	NONDESTRUCTIVE TESTING OF DIFFUSION BONDED TITANIUM ALLOYS FOR ENGINE AND AIRFRAME COMPONENTS	203842/006
NONLINEAR	DEVELOPMENT OF CHALCOPYRITE CRYSTALS FOR NONLINEAR OPTICAL APPLICATIONS	069009/022

NONLINEAR	ADAPTIVE NONLINEAR SIGNAL PROCESSING FOR CHARACTERIZATION OF ULTRASONIC NOE WAVEFORMS TASK I INFERENCE OF FLATBOTTOM HOLE SIZE	203736/012
NONLINEAR	NONLINEAR DEFORMATION OF GRAPHITIC MATERIALS	203565/066
NON-CONSERVATIV	MODAL ANALYSIS OF LINEAR NON-CONSERVATIVE SYSTEMS	203774/011
NON-SPECULAR	NON-SPECULAR COATINGS	204095/063
NOSETIP	EX DEV OF HYPERSONIC HEAT TRANSFER AND THERMOCHEMICAL ABLATION OF ADV MATLS NOSETIP TEST DATA EVAL AND ROUGH WALL TRANSITION	203847/069
NOSETIP	REENTRY VEHICLE NOSETIP STRESS ANALYSIS	204125/072
NOSETIPS	ADVANCED PROTECTIVE MATERIALS FOR REENTRY MISSILE NOSETIPS PT I THREE-DIMENSIONAL REINFORCED CARBON/PLASTIC COMPOSITES	203826/058
NOTCH	NOTCH TENSILE STRENGTH OF ADVANCED STRUCTURAL GRADES OF BERYLLIUM	203675/007
NOTCHING	NOTCHING MACHINE MANUFACTURING METHODS	200988/033
NOVEL	NOVEL BLOCK COPOLYMERS	203412/046
OBSERVATIONS	THE EFFECTS OF REST-TIME ON FATIGUE CRACK RETARDATION AND OBSERVATIONS	204059/015
OCTOBER	PROCEEDINGS OF THE 1974 TRISERVICE CORROSION OF MILITARY EQUIPMENT CONFERENCE 29-31 OCTOBER 1974 VOL II SESSION IV THROUGH VII	204110/070
OIL	DEVELOPMENT OF A GAS TURBINE ENGINE OIL FOR BULK OIL TEMPERATURES OF -40 TO 465 F	203680/051
OIL	DEVELOPMENT OF A GAS TURBINE ENGINE OIL FOR BULK OIL TEMPERATURES OF -40 TO 465 F	203680/051
OILS	PERFORMANCE OF LUBRICANTS OILS AND GREASES IN WEAR TESTS AND COMPACT MATERIALS IN BALL BEARINGS	203570/055
OMEGA	EFFECT OF OMEGA PHASE ON SELECTED PROPERTIES OF BETA III TITANIUM ALLOY	203845/013



OPEN	A STRESS INTENSITY FACTOR CALIBRATION FOR CORNER FLAWS AT AN OPEN HOLE	203519/010
OPTICAL	DEVELOPMENT OF CHALCOPYRITE CRYSTALS FOR NONLINEAR OPTICAL APPLICATIONS	069009/022
OPTIMIZATION	THERMOCHEMICAL ABLATION OF AROMATIC/HETEROCYCLIC POLYMERIC COMPOSITES PART III MATERIAL ELEMENTAL COMPOSITION PERFORMANCE OPTIMIZATION	203434/042
ORTHOTROPIC	DOASIS A COMPUTER CODE FOR THE DEFORMATION PLASTIC ORTHOTROPIC AXISYMMETRIC AND PLANE SOLUTION OF INELASTIC SOLIDS	204136/070
OXIDATION	OXIDATION BEHAVIOR OF TITANIUM ALLOYS UNDER HIGH HEATING RATES	203776/008
OXYARYLENE	SYNTHESIS OF OXYARYLENE RRR POLYMERS	203897/053
PANEL	SUMMARY REPORT ON THE AIR FORCE/INDUSTRY COST REDUCTION PROGRAM RADAR PANEL PHASE II	204123/040
PARAPHENYLENE	SYNTHESIS OF HIGH MOLECULAR WEIGHT PARAPHENYLENE PBI	203337/048
PBI	SYNTHESIS OF HIGH MOLECULAR WEIGHT PARAPHENYLENE PBI	203337/048
PENETRATORS	MANUFACTURING METHODS FOR 30MM DEPLETED URANIUM PENETRATORS	203449/033
PERFECTION	PERFECTION OF CALASOAPIND LASER MATERIAL	203502/024
PERFLUOROALIPHA	SYNTHESIS OF PERFLUOROALIPHATIC ETHER MONOMERS	203901/052
PERFORMANCE	SOME EFFECTS OF ENVIRONMENTAL FACTORS ON THE PERFORMANCE OF COATINGS FOR HIGH POWER IN LASERS	203566/024
PERFORMANCE	PERFORMANCE OF LUBRICANTS OILS AND GREASES IN WEAR TESTS AND COMPACT MATERIALS IN BALL BEARINGS	203570/055
PERFORMANCE	THERMOCHEMICAL ABLATION OF AROMATIC/HETEROCYCLIC POLYMERIC COMPOSITES PART III MATERIAL ELEMENTAL COMPOSITION PERFORMANCE OPTIMIZATION	203434/042

PH	EX OF STAT FATIGUE CHARA OF 0.063-INCH MILL-ANNEALED TI-6AL-4V SHEET AND 0.050-INCH HEAT TREATED 17-7 PH STEEL SHEET UNDER SIM F BY F LOADING	202168/038
PHASE	PHASE SHIFTER MANUFACTURING METHODS	203286/031
PHASE	EFFECT OF OMEGA PHASE ON SELECTED PROPERTIES OF BETA III TITANIUM ALLOY	203845/013
PHASE	SUMMARY REPORT ON THE AIR FORCE/INDUSTRY COST REDUCTION PROGRAM RADAR PANEL PHASE II	204123/040
PHOSPHIDE	ZINC ION IMPLANTATION OF SULFUR-DOPED GALLIUM PHOSPHIDE	203626/029
PHYSICAL	THERMAL ELECTRICAL AND PHYSICAL PROPERTY MEASUREMENTS OF LASER WINDOW MATERIALS	201819/026
PHYSICAL	DEVELOPMENT OF ENGINEERING DATA ON THE MECHANICAL AND PHYSICAL PROPERTIES OF ADVANCED COMPOSITE MATERIALS	203772/067
PIQ	ADVANCED ABLATIVE HEATSHIELDS FOR REENTRY MISSILES PT I LOW RECESSION/HIGH STRENGTH PIQ MATRIX FABRICATION STUDY	204009/052
PITCH	GRAPHITE FIBERS FROM PITCH PT III	204004/045
PITCH	GRAPHITE FIBERS FROM PITCH PT II	203205/045
PLANE	DOASIS A COMPUTER CODE FOR THE DEFORMATION PLASTIC ORTHOTROPIC AXISYMMETRIC AND PLANE SOLUTION OF INELASTIC SOLIDS	204136/070
PLANETARY	PLANETARY BALL SWAGING OF WELDED TITANIUM ALLOY TUBING	067738/031
PLASTIC	EFFECT OF PLASTIC PRESTRAIN ON THE TENSILE STRAIN TO FAILURE OF BERYLLIUM	203844/015
PLASTIC	DOASIS A COMPUTER CODE FOR THE DEFORMATION PLASTIC ORTHOTROPIC AXISYMMETRIC AND PLANE SOLUTION OF INELASTIC SOLIDS	204136/070

PLATE	INFLUENCE OF IRON AND SILICON CONTENT ON THE TENSILE PROPERTIES OF 7X75 AND ZR-MOLDED 7X75 ALUMINUM PLATE	204007/019
PLATE	EFFECTS OF PURITY AND PROCESSING ON THE EXFOLIATION CORROSION BEHAVIOR OF 7X75 ALUMINUM PLATE	203885/014
PLATE	PROGRAM TO IMPROVE THE FRACTURE TOUGHNESS AND FATIGUE RESISTANCE OF ALUMINUM SHEET AND PLATE FOR AIRCRAFT APPLICATIONS	202045/004
PLATE	MECHANICAL PROPERTY DATA FOR ALUMINUM ALLOY 2419-T851 PLATE	204031/073
PLATED	PLATED WIRE MASS MEMORY ARRAY MANUFACTURING METHODS	203884/032
PLUME	BASIC RESEARCH ON LASER PLUME CHARACTERIZATION	203714/009
POLYCRYSTALLINE	PROTECTIVE-ANTIREFLECTIVE THIN FILMS FOR POLYCRYSTALLINE ZINC SELENIDE AND ALKALI HALIDE LASER WINDOWS	203173/025
POLYESTER/WOOL	DEVELOPMENT OF POLYESTER/WOOL UNIFORM FABRIC WITH IMPROVED DURABILITY AND APPEARANCE	204039/061
POLYFLUOROALKYL	POLYFLUOROALKYL-ALKYL POLYSILOXANE GREASE FOR INSTRUMENT LUBRICATION	203351/053
POLYFUNCTIONAL	POLYFUNCTIONAL FLUOROCARBON DERIVATIVES FOR CHEMICAL RESISTANT ELASTOMERS AND CROSSLINKING SYSTEMS	203535/050
POLYMER	POLYMER STRUCTURES AND PROPERTIES PART IV THERMALLY STABLE POLYMERS	203895/041
POLYMERIC	THE ROLE OF TRANSIENT SPECTRUM AND DAMPING ANALYSIS IN ASSESSING THE STRENGTH OF POLYMERIC ADHESIVE METAL BONDING	203522/010
POLYMERIC	SKYLAB 0024 THERMAL CONTROL COATINGS AND POLYMERIC FILMS EXPERIMENT	203823/059
POLYMERIC	RESULTS OF THE POLYMERIC FILMS SKYLAB 0024 EXPERIMENT	203900/063
POLYMERIC	INFRARED TRANSPARENT POLYMERIC FILMS	203794/057



POLYMERIC	THERMOCHEMICAL ABLATION OF AROMATIC/HETEROCYCLIC POLYMERIC COMPOSITES PART III MATERIAL ELEMENTAL COMPOSITION PERFORMANCE OPTIMIZATION	203434/042
POLYMERS	NEW ELASTOMERIC POLYMERS AND SPECIALTY CHEMICALS	203883/060
POLYMERS	SYNTHESIS OF THERMALLY STABLE POLYMERS	203982/060
POLYMERS	MOLECULAR TAILORING OF FLUOROCARBON ETHER BIBENZOXAZOLE POLYMERS TO LOWER GLASS TRANSITION TEMPERATURES	204008/054
POLYMERS	HIGH TEMPERATURE RESISTANT ELASTOMERS OR COMPLIANT POLYMERS	203297/042
POLYMERS	POLYMER STRUCTURES AND PROPERTIES PART IV THERMALLY STABLE POLYMERS	203895/041
POLYMERS	APPARATUS AND TECHNIQUES USED FOR CASTING FILMS OF AROMATIC HETEROCYCLIC POLYMERS	203572/052
POLYMERS	SYNTHESIS OF QUINOZALINE POLYMERS BY INTERMOLECULAR CYCLIZATION	203882/053
POLYMERS	SYNTHESIS OF OXYARYLENE BBR POLYMERS	203897/053
POLYMERS	SYNTHESIS OF NEW SEMI-ORGANIC POLYMERS	203209/045
POLYSILOXANE	POLYFLUOROALKYL-ALKYL POLYSILOXANE GREASE FOR INSTRUMENT LUBRICATION	203351/053
POWDER	HOT ISOSTATIC PRESSING OF TI-6AL-4V POWDER FORGING PREFORMS	202196/034
POWDER	DEVELOPMENT OF HOT ISOSTATIC PRESSING TECHNIQUES FOR PRODUCING HIGH QUALITY BILLET FROM TITANIUM ALLOY POWDER	203881/012
POWDER	THE EVALUATION OF TI-6AL-6V-2SN PRE-ALLOYED POWDER PROCESSING	203889/071
POWDERS	A TEST METHOD FOR EVALUATION OF METAL POWDERS	204135/020
POWER	SOME EFFECTS OF ENVIRONMENTAL FACTORS ON THE PERFORMANCE OF COATINGS FOR HIGH POWER IN LASERS	203566/024
PPQ	PPQ ADHESIVES FOR LARGE AREA BONDING OF TITANIUM ALLOYS	204106/062

PRCO5	MAGNETIC RELAXATION EFFECTS IN PRC05 AND SMXND1-XCO5 INDUCED BY HYDROGEN AND DEUTERIUM	203569/023
PREDICTION	RADIANT HEATING OF AEROSPACE MATERIALS PT II LASER EFFECTS PREDICTION PROCEDURE CODE	204003/046
PREFORMS	HOT ISOSTATIC PRESSING OF TI-6AL-4V POWDER FORGING PREFORMS	202196/034
PREFORMS	MANUFACTURING PROCESS FOR THE DENSIFICATION OF COMPLEX SHAPED WOVEN COMPOSITE PREFORMS	203848/037
PRELIMINARY	A PRELIMINARY STUDY OF FATIGUE CRACK RETARDATION USING LASER INTERFEROMETRY TO MEASURE CRACK SURFACE DISPLACEMENTS	203807/005
PRESSURES	DETERMINATION OF CHANGES IN LUBRICANT VISCOSITIES AT HIGH PRESSURES AND TEMPERATURES	203255/047
PRESTRAIN	EFFECT OF PLASTIC PRESTRAIN ON THE TENSILE STRAIN TO FAILURE OF BERYLLIUM	203844/015
PRE-ALLOYED	THE EVALUATION OF TI-6AL-6V-2SN PRE-ALLOYED POWDER PROCESSING	203889/071
PRIMARY	LOW COST MANUFACTURING CONCEPTS OF ADVANCED COMPOSITE PRIMARY AIRCRAFT	203059/039
PRIMARY	MANUFACTURING METHODS FOR FABRICATION AND ASSEMBLY OF ADVANCED COMPOSITE PRIMARY AIRCRAFT STRUCTURE	202878/038
PRIMATES	EXPLORATORY DEVELOPMENT TO STUDY THE LONG-TERM EFFECTS OF RESORBABLE CERAMICS IN PRIMATES	204006/020
PROBABILISTIC	RELIABILITY ASSESSMENT OF AIRCRAFT STRUCTURES BASED ON PROBABILISTIC INTERPRETATION OF THE SCATTER FACTOR	203804/005
PROBLEM	INFERRING MECHANICAL RELAXATION SPECTRA AN ILL-POSED PROBLEM	203851/051
PROCEEDINGS	PROCEEDINGS OF THE FOURTH ANNUAL CONFERENCE ON INFRARED LASER WINDOW	204097/029
PROCEEDINGS	PROCEEDINGS OF THE 1974 TRISERVICE CORROSION OF MILITARY EQUIPMENT CONFERENCE 29-31 OCTOBER 1974 VOL II SESSION IV THROUGH VII	204110/070

PROPAGATION	CRACK PROPAGATION CHARACTERISTICS IN THREE DEEP HARDENABLE TITANIUM ALLOYS	204112/016
PROPERTIES	INFLUENCE OF IRON AND SILICON CONTENT ON THE TENSILE PROPERTIES OF 7X75 AND 7R-MOLDED 7X75 ALUMINUM PLATE	204007/019
PROPERTIES	MECHANICAL PROPERTIES OF STRUCTURAL GRADES OF BERYLLIUM AT HIGH STRAIN RATES	204099/020
PROPERTIES	EFFECT OF OMEGA PHASE ON SELECTED PROPERTIES OF BETA III TITANIUM ALLOY	203845/013
PROPERTIES	STATIC AND DYNAMIC FRACTURE PROPERTIES FOR ALUMINUM ALLOY 7475-T651 AND T7351	203783/069
PROPERTIES	DETERMINATION OF SELECTED MIL-HDBK-5 DESIGN ALLOWABLE PROPERTIES FOR FIVE AEROSPACE MATERIALS	203806/071
PROPERTIES	INVESTIGATION OF GAGE AND BEARING INSTABILITY IN DESPUN ANTENNA BEARINGS DUE TO CHANGES IN LUBRICANT PROPERTIES	203888/055
PROPERTIES	DEVELOPMENT OF ENGINEERING DATA ON THE MECHANICAL AND PHYSICAL PROPERTIES OF ADVANCED COMPOSITE MATERIALS	203772/067
PROPERTIES	POLYMER STRUCTURES AND PROPERTIES PART IV THERMALLY STABLE POLYMERS	203895/041
PROPERTIES	HYDROFLUOROCARBON SEALANTS WITH IMPROVED LOW TEMPERATURE AND STRESS CORROSION PROPERTIES	203359/044
PROPERTY	THERMAL ELECTRICAL AND PHYSICAL PROPERTY MEASUREMENTS OF LASER WINDOW MATERIALS	201819/026
PROPERTY	MICROSTRUCTURE MECHANICAL PROPERTY RELATIONSHIP IN SUPERALLOYS	204114/019
PROPERTY	MECHANICAL PROPERTY DATA FOR ALUMINUM ALLOY 2419-T851 PLATE	204031/073
PROTECTIVE	ADVANCED PROTECTIVE MATERIALS FOR REENTRY MISSILE NOSETIPS PT I THREE-DIMENSIONAL REINFORCED CARBON/PLASTIC COMPOSITES	203826/058
PROTECTIVE	EXPLORATORY DEVELOPMENT OF COATED FABRIC FOR FIREFIGHTERS PROTECTIVE CLOTHING	203891/059



PROTECTIVE-ANTI	PROTECTIVE-ANTIREFLECTIVE THIN FILMS FOR POLYCRYSTALLINE ZINC SELENIDE AND ALKALI HALIDE LASER WINDOWS	203173/025
PT	STRESS-CORROSION CRACKING OF METALLIC MATERIALS PT III HYDROGEN ENTRY AND EMBRITTLEMENT IN STEEL	203562/004
PT	ADVANCED PROTECTIVE MATERIALS FOR REENTRY MISSILE NOSETIPS PT I THREE-DIMENSIONAL REINFORCED CARBON/PLASTIC COMPOSITES	203826/058
PT	GRAPHITE FIBERS FROM PITCH PT II	203205/045
PT	RADIANT HEATING OF AEROSPACE MATERIALS PT II LASER EFFECTS PREDICTION PROCEDURE CODE	204003/046
PT	GRAPHITE FIBERS FROM PITCH PT III	204004/045
PT	ADVANCED ABLATIVE HEATSHIELDS FOR REENTRY MISSILES PT I LOW RECESSION/HIGH STRENGTH PIO MATRIX FABRICATION STUDY	204009/052
PT	ACCELERATED CHARACTERIZATION OF FIBER/EPOXY COMPOSITES PT I VISCOELASTIC METHODS	203433/052
PT	IMPROVED ATJS GRAPHITE PT I MATERIALS AND PROCESS STUDIES	203347/047
PURITY	EFFECTS OF PURITY AND PROCESSING ON THE EXFOLIATION CORROSION BEHAVIOR OF 7X75 ALUMINUM PLATE	203885/014
PYROELECTRIC	PYROELECTRIC FILM/LIQUID CRYSTAL DETECTOR FOR 10.6 UM REGION	203442/022
QUINOZALINE	SYNTHESIS OF QUINOZALINE POLYMERS BY INTERMOLECULAR CYCLIZATION	203882/053
RADAR	SUMMARY REPORT ON THE AIR FORCE/INDUSTRY COST REDUCTION PROGRAM RADAR PANEL PHASE II	204123/040
RADIALLY	TWO-DIMENSIONAL STRESS INTENSITY FACTOR SOLUTIONS FOR RADIALLY CRACKED RINGS	204057/018
RADIANT	RADIANT HEATING OF AEROSPACE MATERIALS PT II LASER EFFECTS PREDICTION PROCEDURE CODE	204003/046
RADIATION	AEROSPACE MATERIALS RESPONSE TO INTENSE THERMAL RADIATION	204108/060

RAIN	HIGH TEMPERATURES STABLE SUBSONIC RAIN EROSION RESISTANT FLUOROELASTOMERS COATINGS DEVELOPMENT	203793/057
RANGE	ON THE SHAPE OF ERODING BODIES WITH APPLICATION TO BALLISTIC RANGE EROSION TESTS	204103/063
RAPIDLY	MANUFACTURING METHODS FOR RAPIDLY CURING ADVANCED COMPOSITES	201787/039
RATE	DYNAMIC COMPRESSIVE STRAIN RATE TESTS ON SEVERAL GRADES OF BERYLLIUM	203344/006
RATES	MECHANICAL PROPERTIES OF STRUCTURAL GRADES OF BERYLLIUM AT HIGH STRAIN RATES	204099/020
RATES	OXIDATION BEHAVIOR OF TITANIUM ALLOYS UNDER HIGH HEATING RATES	203776/008
RECESSION/HIGH	ADVANCED ABLATIVE HEATSHIELDS FOR REENTRY MISSILES PT I LOW RECESSION/HIGH STRENGTH PIQ MATRIX FABRICATION STUDY	204009/052
RECOMMENDATION	EXPLORATORY DEVELOPMENT ON THE FEASIBILITY AND RECOMMENDATION FOR NOI OF IR WINDOWS	203345/022
REDUNDANT	RELIABILITY AND RISK ASSESSMENT METHODS AND REDUNDANT STRUCTURES	204096/003
REENTRY	ADVANCED PROTECTIVE MATERIALS FOR REENTRY MISSILE NOSETIPS PT I THREE-DIMENSIONAL REINFORCED CARBON/PLASTIC COMPOSITES	203826/058
REENTRY	SHOCK LAYER SHATTERING OF WATER DROPS AND ICE CRYSTALS IN REENTRY	203843/059
REENTRY	REENTRY VEHICLE NOSETIP STRESS ANALYSIS	204125/072
REENTRY	ADVANCED REENTRY MISSILE HEATSHIELD MATERIALS PART III: HIGH STRAIN/STRENGTH FIBER MULTIDIRECTIONAL REINFORCED THERMALLY STABLE MATRIX COMPONENTS	203294/043
REENTRY	ADVANCED ABLATIVE HEATSHIELDS FOR REENTRY MISSILES PT I LOW RECESSION/HIGH STRENGTH PIQ MATRIX FABRICATION STUDY	204009/052
REFINEMENT	GRAIN REFINEMENT OF TITANIUM ALLOYS	203457/008

REGION	FLUORIDE WINDOW MATERIALS FOR USE AS LASER WINDOWS IN THE 2 TO 6 UM SPECTRAL REGION	203698/028
REGION	PYROELECTRIC FILM/LIQUID CRYSTAL DETECTOR FOR 10.6 UM REGION	203442/022
REINFORCED	MICROSTRUCTURAL RELATIONSHIPS IN 2-2-3 CARBON REINFORCED CARBON COMPOSITES	204033/073
REINFORCED	ADVANCED PROTECTIVE MATERIALS FOR REENTRY MISSILE NOSETIPS PT I THREE-DIMENSIONAL REINFORCED CARBON/PLASTIC COMPOSITES	203826/058
REINFORCED	ADVANCED REENTRY MISSILE HEATSHIELD MATERIALS PART III: HIGH STRAIN/STRENGTH FIBER MULTIDIRECTIONAL REINFORCED THERMALLY STABLE MATRIX COMPONENTS	203294/043
RELATIONSHIP	MICROSTRUCTURE MECHANICAL PROPERTY RELATIONSHIP IN SUPERALLOYS	204114/019
RELATIONSHIPS	MICROSTRUCTURAL RELATIONSHIPS IN 2-2-3 CARBON REINFORCED CARBON COMPOSITES	204033/073
RELAXATION	MAGNETIC RELAXATION EFFECTS IN PRC05 AND SMXND1-XC05 INDUCED BY HYDROGEN AND DEUTERIUM	203569/023
RELAXATION	INFERRING MECHANICAL RELAXATION SPECTRA AN ILL-POSED PROBLEM	203851/051
RELIABILITY	RELIABILITY AND RISK ASSESSMENT METHODS AND REDUNDANT STRUCTURES	204096/003
RELIABILITY	RELIABILITY ASSESSMENT OF AIRCRAFT STRUCTURES BASED ON PROBABILISTIC INTERPRETATION OF THE SCATTER FACTOR	203804/005
RENE	LOW CYCLE FATIGUE CRACK INITIATION STUDY IN RENE 95	204036/011
REPAIR	MANUFACTURING METHODS FOR ENGINE BLADE REPAIR	201540/034
REPAIR	ADHESIVE BONDED AEROSPACE STRUCTURES STANDARDIZED REPAIR HANDBOOK	203983/075
REQUIREMENT	IMPROVED INSULATOR MATERIALS REQUIREMENT PROGRAM	203389/065



RESISTANCE	PROGRAM TO IMPROVE THE FRACTURE TOUGHNESS AND FATIGUE RESISTANCE OF ALUMINUM SHEET AND PLATE FOR AIRCRAFT APPLICATIONS	202045/004
RESISTANCE	MATERIALS VARIABLES AFFECTING THE IMPACT RESISTANCE OF GRAPHITE AND BORON COMPOSITES PART II	203894/048
RESISTANT	HIGH TEMPERATURES STABLE SUBSONIC RAIN EROSION RESISTANT FLUOROELASTOMERS COATINGS DEVELOPMENT	203793/057
RESISTANT	DEVELOPMENT OF CORROSION RESISTANT SURFACE TREATMENTS FOR ALUMINUM ALLOYS FOR SPOT-WELD BONDING	204038/058
RESISTANT	THERMAL FLASH RESISTANT IR SUPPRESSION COATINGS FOR ADVANCED AIRCRAFT SYSTEMS	203750/050
RESISTANT	POLYFUNCTIONAL FLUOROCARBON DERIVATIVES FOR CHEMICAL RESISTANT ELASTOMERS AND CROSSLINKING SYSTEMS	203535/050
RESISTANT	HIGH TEMPERATURE RESISTANT ELASTOMERS OR COMPLIANT POLYMERS	203297/042
RESORBABLE	EXPLOATORY DEVELOPMENT TO STUDY THE LONG-TERM EFFECTS OF RESORBABLE CERAMICS IN PRIMATES	204006/020
RESPONSE	THERMAL RESPONSE OF WOVEN AND KNITTED FABRICS IN JP-4 FUEL FIRE ENVIRONMENT	204134/057
RESPONSE	THERMOSTRUCTURAL RESPONSE OF CARBON/CARBON MATERIALS UNDER HIGH HEAT FLUX ENVIRONMENTS	203623/065
RESPONSE	AEROSPACE MATERIALS RESPONSE TO INTENSE THERMAL RADIATION	204108/060
REST-TIME	THE EFFECTS OF REST-TIME ON FATIGUE CRACK RETARDATION AND OBSERVATIONS	204059/015
RESULTS	F-15 COMPOSITE WING VOL II DEVELOPMENT AND TEST RESULTS	069613/002
RESULTS	F-15 COMPOSITE WING VOL I DEVELOPMENT AND TEST RESULTS	069613/002
RESULTS	RESULTS OF THE POLYMERIC FILMS SKYLAB D024 EXPERIMENT	203900/063

RESULTS	THE CARBON/CARBON ASSESSMENT PROGRAM 50 MW ABLATION TESTING AND RESULTS	204048/065
RETARDATION	A PRELIMINARY STUDY OF FATIGUE CRACK RETARDATION USING LASER INTERFEROMETRY TO MEASURE CRACK SURFACE DISPLACEMENTS	203807/005
RETARDATION	THE EFFECTS OF REST-TIME ON FATIGUE CRACK RETARDATION AND OBSERVATIONS	204059/015
RING	THE DEVELOPMENT AND DEMONSTRATION OF A HIGH TEMPERATURE RING TEST FACILITY	203415/066
RINGS	TWO-DIMENSIONAL STRESS INTENSITY FACTOR SOLUTIONS FOR RADIALY CRACKED RINGS	204057/018
RISK	RELIABILITY AND RISK ASSESSMENT METHODS AND REDUNDANT STRUCTURES	204096/003
ROLE	THE ROLE OF TRANSIENT SPECTRUM AND DAMPING ANALYSIS IN ASSESSING THE STRENGTH OF POLYMERIC ADHESIVE METAL BONDING	203522/010
ROUGH	EX DEV OF HYPERSONIC HEAT TRANSFER AND THERMOCHEMICAL ABLATION OF ADV MATLS NOSETIP TEST DATA EVAL AND ROUGH WALL TRANSITION	203847/069
SCATTER	RELIABILITY ASSESSMENT OF AIRCRAFT STRUCTURES BASED ON PROBABILISTIC INTERPRETATION OF THE SCATTER FACTOR	203804/005
SCHOCK	THE STUDY OF THE EFFECT OF SCHOCK INTERACTION ON AXISYMMETRIC CONCAVE CONIC SHAPES IN HYPERSONIC FLOW	204109/074
SEALANT	DYNAMICS AND STATIC EVALUATION OF EXPERIMENTAL FUEL TANK SEALANT MATERIALS	203892/051
SEALANTS	HYBRID FLUROSILICONES FOR AIRCRAFT FUEL TANK SEALANTS	203981/041
SEALANTS	HYDROFLUOROCARBON SEALANTS WITH IMPROVED LOW TEMPERATURE AND STRESS CORROSION PROPERTIES	203359/044
SEALS	LONG LIFE ELASTOMERIC AIRCRAFT HYDRAULIC SEALS	203217/044
SELENIDE	HARDENED CVD ZINC SELENIDE FOR FLIR WINDOWS	204037/030

SELENIDE	PROTECTIVE-ANTIREFLECTIVE THIN FILMS FOR POLYCRYSTALLINE ZINC SELENIDE AND ALKALI HALIDE LASER WINDOWS	203173/025
SEMICONDUCTORS	ROOM TEMPERATURE INJECTION LUMINESCENCE IN II-VI SEMICONDUCTORS	201818/023
SEMICONDUCTORS	CHEMICAL VAPOR DEPOSITION OF CHALCOGENIDE SEMICONDUCTORS	204098/029
SEMI-ORGANIC	SYNTHESIS OF NEW SEMI-ORGANIC POLYMERS	203209/045
SEM/TEM	SEM/TEM FRACTOGRAPHY HANDBOOK	REF263/076
SENSITIVITY	PRACTICAL SENSITIVITY LIMITS OF PRODUCTION NONDESTRUCTIVE TESTING METHODS IN ALUMINUM AND STEEL	203852/007
SESSION	PROCEEDINGS OF THE 1974 TRISERVICE CORROSION OF MILITARY EQUIPMENT CONFERENCE 29-31 OCTOBER 1974 VOL II SESSION IV THROUGH VII	204110/070
SHAPE	ON THE SHAPE OF ERODING BODIES WITH APPLICATION TO BALLISTIC RANGE EROSION TESTS	204103/063
SHAPED	MANUFACTURING PROCESS FOR THE DENSIFICATION OF COMPLEX SHAPED WOVEN COMPOSITE PREFORMS	203848/037
SHAPES	THE STUDY OF THE EFFECT OF SCHOCK INTERACTION ON AXISYMMETRIC CONCAVE CONIC SHAPES IN HYPERSONIC FLOW	204109/074
SHATTERING	SHOCK LAYER SHATTERING OF WATER DROPS AND ICE CRYSTALS IN REENTRY	203843/059
SHEET	EX OF STAT FATIGUE CHARA OF 0.063-INCH MILL-ANNEALED TI-6AL-4V SHEET AND 0.050-INCH HEAT TREATED 17-7 PH STEEL SHEET UNDER SIM F BY F LOADING	202168/008
SHEET	EX OF STAT FATIGUE CHARA OF 0.063-INCH MILL-ANNEALED TI-6AL-4V SHEET AND 0.050-INCH HEAT TREATED 17-7 PH STEEL SHEET UNDER SIM F BY F LOADING	202168/008
SHEET	PROGRAM TO IMPROVE THE FRACTURE TOUGHNESS AND FATIGUE RESISTANCE OF ALUMINUM SHEET AND PLATE FOR AIRCRAFT APPLICATIONS	202045/004



SHIFTER	PHASE SHIFTER MANUFACTURING METHODS	203286/031
SHOCK	WATER DROP/BOW SHOCK INTERACTIONS	204094/018
SHOCK	SHOCK LAYER SHATTERING OF WATER DROPS AND ICE CRYSTALS IN REENTRY	203843/059
SIGNAL	ADAPTIVE NONLINEAR SIGNAL PROCESSING FOR CHARACTERIZATION OF ULTRASONIC NOISE WAVEFORMS TASK I INFERENCE OF FLATBOTTOM HOLE SIZE	203736/012
SILICON	INFLUENCE OF IRON AND SILICON CONTENT ON THE TENSILE PROPERTIES OF 7X75 AND ZR-MOLDED 7X75 ALUMINUM PLATE	204007/019
SIM	EX OF STAT FATIGUE CHARA OF 0.063-INCH MILL-ANNEALED TI-6AL-4V SHEET AND 0.050-INCH HEAT TREATED 17-7 PH STEEL SHEET UNDER SIM F BY F LOADING	202168/008
SINGLE	GROWTH OF DOPED AND UNDOPED SINGLE CRYSTAL LASER MATERIALS IN THE SYSTEM (MF2)XX(YF3)1-X	203787/027
SKYLAB	RESULTS OF THE POLYMERIC FILMS SKYLAB D024 EXPERIMENT	203900/063
SKYLAB	SKYLAB D024 THERMAL CONTROL COATINGS AND POLYMERIC FILMS EXPERIMENT	203823/059
SMXND1-XC05	MAGNETIC RELAXATION EFFECTS IN PRC05 AND SMXND1-XC05 INDUCED BY HYDROGEN AND DEUTERIUM	203569/023
SOLID	EXPLORATORY DEVELOPMENT OF MAGNETIC BUBBLE DOMAIN MATERIAL FOR APPLICATION IN AIR FORCE SOLID STATE MASS MEMORY SYSTEMS	203799/035
SOLIDIFICATION	AUTOMATED DIRECTIONAL SOLIDIFICATION OF SUPERALLOYS	204102/040
SOLIDS	DOASIS A COMPUTER CODE FOR THE DEFORMATION PLASTIC ORTHOTROPIC AXISYMMETRIC AND PLANE SOLUTION OF INELASTIC SOLIDS	204136/070
SOLUTION	DOASIS A COMPUTER CODE FOR THE DEFORMATION PLASTIC ORTHOTROPIC AXISYMMETRIC AND PLANE SOLUTION OF INELASTIC SOLIDS	204136/070
SOLUTIONS	TWO-DIMENSIONAL STRESS INTENSITY FACTOR SOLUTIONS FOR RADially CRACKED RINGS	204057/018

SPACEFLIGHT	ML-101 THERMAL CONTROL COATING SPACEFLIGHT EXPERIMENT	204133/054
SPECIALTY	NEW ELASTOMERIC POLYMERS AND SPECIALTY CHEMICALS	203883/050
SPECTRA	COMPUTER ANALYSIS OF THE MASS SPECTRA OF GAS MIXTURES	203356/047
SPECTRA	INFERRING MECHANICAL RELAXATION SPECTRA AN ILL-POSED PROBLEM	203851/051
SPECTRAL	FLUORIDE WINDOW MATERIALS FOR USE AS LASER WINDOWS IN THE 2 TO 6 UM SPECTRAL REGION	203898/028
SPECTRUM	THE ROLE OF TRANSIENT SPECTRUM AND DAMPING ANALYSIS IN ASSESSING THE STRENGTH OF POLYMERIC ADHESIVE METAL BONDING	203522/010
SPINEL	MANUFACTURING METHODS FOR SPINEL FERRITES FOR USE IN MICROWAVE TUBES	203375/032
SPLICE	DEVELOPMENT OF IMPROVED CORE SPLICE ADHESIVES	204005/056
SPOT-WELD	DEVELOPMENT OF CORROSION RESISTANT SURFACE TREATMENTS FOR ALUMINUM ALLOYS FOR SPOT-WELD BONDING	204038/058
STABLE	HIGH TEMPERATURES STABLE SUBSONIC RAIN EROSION RESISTANT FLUOROELASTOMERS COATINGS DEVELOPMENT	203793/057
STABLE	SYNTHESIS OF THERMALLY STABLE POLYMERS	203982/050
STABLE	ADVANCED REENTRY MISSILE HEATSHIELD MATERIALS PART III: HIGH STRAIN/STRENGTH FIBER MULTIDIRECTIONAL REINFORCED THERMALLY STABLE MATRIX COMPONENTS	203294/043
STABLE	POLYMER STRUCTURES AND PROPERTIES PART IV THERMALLY STABLE POLYMERS	203895/041
STABLE	HIGH TEMPERATURE THERMALLY STABLE GREASES	203409/042
STANDARDIZED	ADHESIVE BONDED AEROSPACE STRUCTURES STANDARDIZED REPAIR HANDBOOK	203983/075
STAT	EX OF STAT FATIGUE CHARA OF 0.063-INCH MILL-ANNEALED TI-6AL-4V SHEET AND 0.050-INCH HEAT TREATED 17-7 PH STEEL SHEET UNDER SIM FRY F LOADING	202168/008

STATIC	STATIC AND DYNAMIC FRACTURE PROPERTIES FOR ALUMINUM ALLOY 7475-T651 AND T7351	203783/069
STATIC	DYNAMICS AND STATIC EVALUATION OF EXPERIMENTAL FUEL TANK SEALANT MATERIALS	203892/051
STEEL	PRACTICAL SENSITIVITY LIMITS OF PRODUCTION NONDESTRUCTIVE TESTING METHODS IN ALUMINUM AND STEEL	203852/007
STEEL	EX OF STAT FATIGUE CHARA OF 0.063-INCH MILL-ANNEALED TI-6AL-4V SHEET AND 0.050-INCH HEAT TREATED 17-7 PH STEEL SHEET UNDER SIM F BY F LOADING	202168/008
STEEL	STRESS-CORROSION CRACKING OF METALLIC MATERIALS PT III HYDROGEN ENTRY AND EMBRITTLEMENT IN STEEL	203562/004
STEELS	RESEARCH TOWARD HIGH STRENGTH HIGH TOUGHNESS STEELS	204100/018
STRAIN	MECHANICAL PROPERTIES OF STRUCTURAL GRADES OF BERYLLIUM AT HIGH STRAIN RATES	204099/020
STRAIN	EFFECT OF PLASTIC PRESTRAIN ON THE TENSILE STRAIN TO FAILURE OF BERYLLIUM	203444/015
STRAIN	DYNAMIC COMPRESSIVE STRAIN RATE TESTS ON SEVERAL GRADES OF BERYLLIUM	203344/006
STRAIN	ANALYSIS OF HIGH STRAIN GRAPHITE	203438/055
STRAIN/STRENGTH	ADVANCED REENTRY MISSILE HEATSHIELD MATERIALS PART III: HIGH STRAIN/STRENGTH FIBER MULTIDIRECTIONAL REINFORCED THERMALLY STABLE MATRIX COMPONENTS	203294/043
STRENGTH	STRENGTH CHARACTERISTICS OF BORON ALUMINUM COMPOSITE SUBJECTED TO COMBINED STRESSES	203507/006
STRENGTH	THE ROLE OF TRANSIENT SPECTRUM AND DAMPING ANALYSIS IN ASSESSING THE STRENGTH OF POLYMERIC ADHESIVE METAL BONDING	203522/010
STRENGTH	NOTCH TENSILE STRENGTH OF ADVANCED STRUCTURAL GRADES OF BERYLLIUM	203675/007
STRENGTH	RESEARCH TOWARD HIGH STRENGTH HIGH TOUGHNESS STEELS	204100/018



STRENGTH	ADVANCED ABLATIVE HEATSHIELDS FOR REENTRY MISSILES PT I LOW RECESSION/HIGH STRENGTH PIQ MATRIX FABRICATION STUDY	204009/052
STRESS	TWO-DIMENSIONAL STRESS INTENSITY FACTOR SOLUTIONS FOR RADially CRACKED RINGS	204057/018
STRESS	A STRESS INTENSITY FACTOR CALIBRATION FOR CORNER FLAWS AT AN OPEN HOLE	203819/010
STRESS	DETERMINATION OF STRESS INTENSITY FACTOR FOR COLD-WORKED FASTENER HOLES IN 7075 ALUMINUM USING THE CRACK GROWTH METHOD	203820/010
STRESS	REENTRY VEHICLE NOSETIP STRESS ANALYSIS	204125/072
STRESS	MATERIALS AND APPROACHES FOR IMPROVED STRESS CORROSION INHIBITIVE COATINGS	203218/043
STRESS	HYDROFLUOROCARBON SEALANTS WITH IMPROVED LOW TEMPERATURE AND STRESS CORROSION PROPERTIES	203359/044
STRESSES	STRENGTH CHARACTERISTICS OF BORON ALUMINUM COMPOSITE SUBJECTED TO COMBINED STRESSES	203507/016
STRESSES	STRESSES IN AN ADHESIVE BONDED COMPOSITE-TO-METAL ASSEMBLY	203773/068
STRESS-CORROSION	STRESS-CORROSION CRACKING OF METALLIC MATERIALS PT III HYDROGEN ENTRY AND EMBRITTLEMENT IN STEEL	203562/004
STRUCTURAL	MECHANICAL PROPERTIES OF STRUCTURAL GRADES OF BERYLLIUM AT HIGH STRAIN RATES	204099/020
STRUCTURAL	NOTCH TENSILE STRENGTH OF ADVANCED STRUCTURAL GRADES OF BERYLLIUM	203675/007
STRUCTURAL	RESEARCH ON DEEP HARDENING TITANIUM ALLOY FOR LARGE AIRFRAME STRUCTURAL MEMBERS	203925/013
STRUCTURAL	ENGINEERING DATA ON NEW AEROSPACE STRUCTURAL MATERIALS	203980/072
STRUCTURE	MANUFACTURING METHODS FOR FABRICATION AND ASSEMBLY OF ADVANCED COMPOSITE PRIMARY AIRCRAFT STRUCTURE	202878/038

STRUCTURE	MANUFACTURING METHODS FOR THERMAL EXPANSION MOLDING OF ADVANCED COMPOSITES AIRCRAFT STRUCTURE	203128/038
STRUCTURES	COMPLEMENTARY BIPOLAR TRANSISTOR STRUCTURES	203995/031
STRUCTURES	LOW-TEMPERATURE LARGE-AREA BRAZING OF TITANIUM STRUCTURES	201790/014
STRUCTURES	ADVANCED DEVELOPMENT ON VULNERABILITY/SURVIVABILITY OF ADVANCED COMPOSITE STRUCTURES	069611/002
STRUCTURES	LIFE ASSURANCE OF COMPOSITE STRUCTURES VOL I MOISTURE EFFECTS	203825/002
STRUCTURES	RELIABILITY ASSESSMENT OF AIRCRAFT STRUCTURES BASED ON PROBABILISTIC INTERPRETATION OF THE SCATTER FACTOR	203804/005
STRUCTURES	RELIABILITY AND RISK ASSESSMENT METHODS AND REDUNDANT STRUCTURES	204096/003
STRUCTURES	ADHESIVE BONDED AEROSPACE STRUCTURES STANDARDIZED REPAIR HANDBOOK	203983/075
STRUCTURES	SUPERPLASTIC FORMING OF TITANIUM STRUCTURES	203854/037
STRUCTURES	POLYMER STRUCTURES AND PROPERTIES PART IV THERMALLY STABLE POLYMERS	203995/041
SUBJECTED	STRENGTH CHARACTERISTICS OF BORON ALUMINUM COMPOSITE SUBJECTED TO COMBINED STRESSES	203507/006
SUBSONIC	HIGH TEMPERATURES STABLE SUBSONIC RAIN EROSION RESISTANT FLUOROELASTOMERS COATINGS DEVELOPMENT	203793/057
SULFUR-DOPED	ZINC ION IMPLANTATION OF SULFUR-DOPED GALLIUM PHOSPHIDE	203626/029
SUPERALLOYS	MICROSTRUCTURE MECHANICAL PROPERTY RELATIONSHIP IN SUPERALLOYS	204114/019
SUPERALLOYS	AUTOMATED DIRECTIONAL SOLIDIFICATION OF SUPERALLOYS	204102/040
SUPERCONDUCTING	EXPERIMENTAL HYSTERETIC LOSS FOR A SERIES OF SUPERCONDUCTING FILAMENTARY NBTI WIRES AND A FIELD DEPENDENT CRITICAL STATE MODEL	204035/024

SUPERCONDUCTORS	AC LOSS AS A FUNCTION OF CURRENT AND EXTERNAL MAGNETIC FIELD IN COMMERCIAL NBTI SUPERCONDUCTORS	203798/026
SUPERPLASTIC	SUPERPLASTIC FORMING OF TITANIUM STRUCTURES	203854/037
SUPPRESSION	THERMAL FLASH RESISTANT IR SUPPRESSION COATINGS FOR ADVANCED AIRCRAFT SYSTEMS	203750/050
SURFACE	A PRELIMINARY STUDY OF FATIGUE CRACK RETARDATION USING LASER INTERFEROMETRY TO MEASURE CRACK SURFACE DISPLACEMENTS	203807/005
SURFACE	DEVELOPMENT OF CORROSION RESISTANT SURFACE TREATMENTS FOR ALUMINUM ALLOYS FOR SPOT-WELD BONDING	204038/058
SURFACE	SURFACE ANALYSIS OF 2024 AND 7075 ALUMINUM ALLOYS AFTER CONDITIONING BY CHEMICAL TREATMENTS	204107/052
SWAGING	PLANETARY BALL SWAGING OF WELDED TITANIUM ALLOY TUBING	067738/031
SYNTHESIS	SYNTHESIS OF THERMALLY STABLE POLYMERS	203982/060
SYNTHESIS	SYNTHESIS OF PERFLUOROALIPHATIC ETHER MONOMERS	203901/062
SYNTHESIS	SYNTHESIS OF HIGH MOLECULAR WEIGHT PARAPHENYLENE PBT	203337/048
SYNTHESIS	SYNTHESIS OF QUINOZALINE POLYMERS BY INTERMOLECULAR CYCLIZATION	203882/053
SYNTHESIS	SYNTHESIS OF NEW SEMI-ORGANIC POLYMERS	203209/045
SYNTHESIS	SYNTHESIS OF OXYARYLENE BBR POLYMERS	203897/053
TAILORING	MOLECULAR TAILORING OF FLUOROCARBON ETHER BIBENZOXAZOLE POLYMERS TO LOWER GLASS TRANSITION TEMPERATURES	204008/054
TANK	HYBRID FLUOROSILICONES FOR AIRCRAFT FUEL TANK SEALANTS	203981/041
TANK	DYNAMICS AND STATIC EVALUATION OF EXPERIMENTAL FUEL TANK SEALANT MATERIALS	203892/051



TASK	ADAPTIVE NONLINEAR SIGNAL PROCESSING FOR CHARACTERIZATION OF ULTRASONIC NOE WAVEFORMS TASK I INFERENCE OF FLATBOTTOM HOLE SIZE	203736/012
TELLURIDE	CHEMICAL VAPOR DEPOSITION OF CADMIUM TELLURIDE	203682/028
TEMPERATURE	ROOM TEMPERATURE INJECTION LUMINESCENCE IN II-VI SEMICONDUCTORS	201818/023
TEMPERATURE	DEVELOPMENT OF HIGH TEMPERATURE ADDITION-CURED ADHESIVES	204032/061
TEMPERATURE	THE DEVELOPMENT AND DEMONSTRATION OF A HIGH TEMPERATURE RING TEST FACILITY	203415/056
TEMPERATURE	DEVELOPMENT OF HIGH TEMPERATURE FUNCTIONAL FLUIDS	203295/043
TEMPERATURE	HIGH TEMPERATURE THERMALLY STABLE GREASES	203409/042
TEMPERATURE	HYDROFLUOROCARBON SEALANTS WITH IMPROVED LOW TEMPERATURE AND STRESS CORROSION PROPERTIES	203359/044
TEMPERATURES	MOLECULAR TAILORING OF FLUOROCARBON ETHER BIBENZOXAZOLE POLYMERS TO LOWER GLASS TRANSITION TEMPERATURES	204008/054
TEMPERATURES	HIGH TEMPERATURES STABLE SUBSONIC RAIN EROSION RESISTANT FLUOROELASTOMERS COATINGS DEVELOPMENT	203793/057
TEMPERATURES	DETERMINATION OF CHANGES IN LUBRICANT VISCOSITIES AT HIGH PRESSURES AND TEMPERATURES	203255/047
TEMPERATURES	DEVELOPMENT OF A GAS TURBINE ENGINE OIL FOR BULK OIL TEMPERATURES OF -40 TO 465 F	203680/051
TENSILE	INFLUENCE OF IRON AND SILICON CONTENT ON THE TENSILE PROPERTIES OF 7X75 AND ZR-MOLDED 7X75 ALUMINUM PLATE	204007/019
TENSILE	EFFECT OF PLASTIC PRESTRAIN ON THE TENSILE STRAIN TO FAILURE OF BERYLLIUM	203844/015
TENSILE	NOTCH TENSILE STRENGTH OF ADVANCED STRUCTURAL GRADES OF BERYLLIUM	203675/007
TENSILE	BIAXIAL TENSILE FRACTURE OF ATJ-S GRAPHITE	203720/066

THERMAL	THERMAL ELECTRICAL AND PHYSICAL PROPERTY MEASUREMENTS OF LASER WINDOW MATERIALS	201819/026
THERMAL	THERMAL RESPONSE OF WOVEN AND KNITTED FABRICS IN JP-4 FUEL FIRE ENVIRONMENT	204134/057
THERMAL	EXPLORATORY DEVELOPMENT TO OBTAIN THERMAL AND MECHANICAL CHARACTERIZATION DATA ON ADVANCED CARBON INSULATION	203760/071
THERMAL	SKYLAB 0024 THERMAL CONTROL COATINGS AND POLYMERIC FILMS EXPERIMENT	203823/059
THERMAL	AEROSPACE MATERIALS RESPONSE TO INTENSE THERMAL RADIATION	204108/060
THERMAL	ML-101 THERMAL CONTROL COATING SPACEFLIGHT EXPERIMENT	204133/054
THERMAL	MANUFACTURING METHODS FOR THERMAL EXPANSION MOLDING OF ADVANCED COMPOSITES AIRCRAFT STRUCTURE	203128/038
THERMAL	THERMAL FLASH RESISTANT IR SUPPRESSION COATINGS FOR ADVANCED AIRCRAFT SYSTEMS	203750/050
THERMAL	INVESTIGATION OF CONTAMINATION EFFECTS OF THERMAL CONTROL	203574/049
THERMALLY	SYNTHESIS OF THERMALLY STABLE POLYMERS	203982/060
THERMALLY	POLYMER STRUCTURES AND PROPERTIES PART IV THERMALLY STABLE POLYMERS	203895/041
THERMALLY	ADVANCED REENTRY MISSILE HEATSHIELD MATERIALS PART III: HIGH STRAIN/STRENGTH FIBER MULTIDIRECTIONAL REINFORCED THERMALLY STABLE MATRIX COMPONENTS	203294/043
THERMALLY	HIGH TEMPERATURE THERMALLY STABLE GREASES	203409/042

THERMOCHEMICAL	EX DEV OF HYPERSONIC HEAT TRANSFER AND THERMOCHEMICAL ABLATION OF ADV MATLS NOSETIP TEST DATA EVAL AND ROUGH WALL TRANSITION	203847/069
THERMOCHEMICAL	THERMOCHEMICAL ABLATION OF AROMATIC/HETEROCYCLIC POLYMERIC COMPOSITES PART III MATERIAL ELEMENTAL COMPOSITION PERFORMANCE OPTIMIZATION	203434/042
THERMOMECHANICA	EXPLORATORY DEVELOPMENT OF HYPERSONIC HEAT TRANSFER AND THERMOMECHANICAL ABLATION OF ADVANCED MATERIALS	203847/070
THERMOSTRUCTURA	THERMOSTRUCTURAL RESPONSE OF CARBON/CARBON MATERIALS UNDER HIGH HEAT FLUX ENVIRONMENTS	203623/065
THERMO-AGING	DATA ACQUISITION AND ANALYSIS OF LONG-TERM THERMO-AGING DEGRADATION DATA	203762/001
THIN	PROTECTIVE-ANTIREFLECTIVE THIN FILMS FOR POLYCRYSTALLINE ZINC SELENIDE AND ALKALI HALIDE LASER WINDOWS	203173/025
TITANIUM	PLANETARY BALL SWAGING OF WELDED TITANIUM ALLOY TUBING	067738/031
TITANIUM	GRAIN REFINEMENT OF TITANIUM ALLOYS	203457/008
TITANIUM	FRACTURE TOUGHNESS AGING BEHAVIOR GRAIN GROWTH AND HARDNESS OF ALPHA-BETA TITANIUM ALLOYS	202433/004
TITANIUM	LOW-TEMPERATURE LARGE-AREA BRAZING OF TITANIUM STRUCTURES	201790/014
TITANIUM	BORON ALUMINUM TITANIUM HYBRID COMPOSITES	203824/007
TITANIUM	NONDESTRUCTIVE TESTING OF DIFFUSION BONDED TITANIUM ALLOYS FOR ENGINE AND AIRFRAME COMPONENTS	203842/006
TITANIUM	OXIDATION BEHAVIOR OF TITANIUM ALLOYS UNDER HIGH HEATING RATES	203776/008
TITANIUM	DEVELOPMENT OF HOT ISOSTATIC PRESSING TECHNIQUES FOR PRODUCING HIGH QUALITY BILLET FROM TITANIUM ALLOY POWDER	203881/012
TITANIUM	FRACTURE TOUGHNESS AND AGING BEHAVIOR OF ALPHA-BETA TITANIUM ALLOYS	204092/017



TITANIUM	CRACK ARREST IN TITANIUM	203886/017
TITANIUM	CRACK PROPAGATION CHARACTERISTICS IN THREE DEEP HARDENABLE TITANIUM ALLOYS	204112/016
TITANIUM	EXPLORATORY DEVELOPMENT OF IMPROVED CUTTING TOOLS FOR TITANIUM	204104/016
TITANIUM	EFFECT OF OMEGA PHASE ON SELECTED PROPERTIES OF BETA III TITANIUM ALLOY	203845/013
TITANIUM	RESEARCH ON DEEP HARDENING TITANIUM ALLOY FOR LARGE AIRFRAME STRUCTURAL MEMBERS	203925/013
TITANIUM	PPG ADHESIVES FOR LARGE AREA BONDING OF TITANIUM ALLOYS	204106/062
TITANIUM	NONCONSUMABLE MELTING OF TITANIUM	200710/037
TITANIUM	SUPERPLASTIC FORMING OF TITANIUM STRUCTURES	203854/037
TI-6AL-4V	HOT ISOSTATIC PRESSING OF TI-6AL-4V POWDER FORGING PREFORMS	202196/034
TI-6AL-4V	EX OF STAT FATIGUE CHARA OF 0.063-INCH MILL-ANNEALED TI-6AL-4V SHEET AND 0.050-INCH HEAT TREATED 17-7 PH STEEL SHEET UNDER SIM F RY F LOADING	202168/008
TI-6AL-6V-2SN	THE EVALUATION OF TI-6AL-6V-2SN PRE-ALLOYED POWDER PROCESSING	203889/071
TOOLS	EXPLORATORY DEVELOPMENT OF IMPROVED CUTTING TOOLS FOR TITANIUM	204104/016
TOP	SOME GENERAL PROGRAMS FOR DESK TOP COMPUTERS	203811/009
TOUGHNESS	PROGRAM TO IMPROVE THE FRACTURE TOUGHNESS AND FATIGUE RESISTANCE OF ALUMINUM SHEET AND PLATE FOR AIRCRAFT APPLICATIONS	202045/004
TOUGHNESS	FRACTURE TOUGHNESS AND AGING BEHAVIOR OF ALPHA-BETA TITANIUM ALLOYS	204092/017
TOUGHNESS	RESEARCH TOWARD HIGH STRENGTH HIGH TOUGHNESS STEELS	204100/018
TOUGHNESS	FRACTURE TOUGHNESS AGING BEHAVIOR GRAIN GROWTH AND HARDNESS OF ALPHA-BETA TITANIUM ALLOYS	202433/004

TRANSFER	EXPLORATORY DEVELOPMENT OF HYPERSONIC HEAT TRANSFER AND THERMOMECHANICAL ABLATION OF ADVANCED MATERIALS	203847/070
TRANSFER	EX DEV OF HYPERSONIC HEAT TRANSFER AND THERMOCHEMICAL ABLATION OF ADV MATLS NOSETIP TEST DATA EVAL AND ROUGH WALL TRANSITION	203847/069
TRANSIENT	THE ROLE OF TRANSIENT SPECTRUM AND DAMPING ANALYSIS IN ASSESSING THE STRENGTH OF POLYMERIC ADHESIVE METAL BONDING	203522/010
TRANSISTOR	COMPLEMENTARY BIPOLAR TRANSISTOR STRUCTURES	203995/031
TRANSITION	EX DEV OF HYPERSONIC HEAT TRANSFER AND THERMOCHEMICAL ABLATION OF ADV MATLS NOSETIP TEST DATA EVAL AND ROUGH WALL TRANSITION	203847/069
TRANSITION	MOLECULAR TAILORING OF FLUOROCARBON ETHER BIRENZOXAZOLE POLYMERS TO LOWER GLASS TRANSITION TEMPERATURES	204008/054
TRANSITION	BOUNDARY LAYER TRANSITION ON BLUNT BODIES IN HYPERSONIC FLOW	203628/075
TRANSMISSIONS	GREASE LUBRICATION OF HELICOPTER TRANSMISSIONS	203846/055
TRANSPARENT	EXPLORATORY DEVELOPMENT OF TRANSPARENT CONDUCTOR MATERIALS	203497/025
TRANSPARENT	INFRARED TRANSPARENT POLYMERIC FILMS	203794/057
TREATED	EX OF STAT FATIGUE CHARA OF 0.063-INCH MILL-ANNEALED TI-6AL-4V SHEET AND 0.050-INCH HEAT TREATED 17-7 PH STEEL SHEET UNDER SIM F BY F LOADING	202168/008
TREATMENTS	DEVELOPMENT OF CORROSION RESISTANT SURFACE TREATMENTS FOR ALUMINUM ALLOYS FOR SPOT-WELD BONDING	204038/058
TRISERVICE	PROCEEDINGS OF THE 1974 TRISERVICE CORROSION OF MILITARY EQUIPMENT CONFERENCE 29-31 OCTOBER 1974 VOL II SESSION IV THROUGH VII	204110/070
TUBES	MANUFACTURING METHODS FOR LOW EMISSION GRID COATINGS FOR BARIUM ACTIVATED CATHODE VACUUM TUBES	203455/033

TUBES	MANUFACTURING METHODS FOR SPINEL FERRITES FOR USE IN MICROWAVE TUBES	203375/032
TUBING	PLANETARY BALL SWAGING OF WELDED TITANIUM ALLOY TUBING	067738/031
TURBINE	DEVELOPMENT OF A GAS TURBINE ENGINE OIL FOR BULK OIL TEMPERATURES OF -40 TO 465 F	203680/051
T7351	STATIC AND DYNAMIC FRACTURE PROPERTIES FOR ALUMINUM ALLOY 7475-T651 AND T7351	203783/059
ULTRASONIC	ADAPTIVE NONLINEAR SIGNAL PROCESSING FOR CHARACTERIZATION OF ULTRASONIC NDE WAVEFORMS TASK I INFERENCE OF FLATBOTTOM HOLE SIZE	203736/012
UM	FLUORIDE WINDOW MATERIALS FOR USE AS LASER WINDOWS IN THE 2 TO 6 UM SPECTRAL REGION	203898/028
UM	PYROELECTRIC FILM/LIQUID CRYSTAL DETECTOR FOR 10.6 UM REGION	203442/022
UNDOPED	GROWTH OF DOPED AND UNDOPED SINGLE CRYSTAL LASER MATERIALS IN THE SYSTEM (MF2)XX(YF3)1-X	203787/027
UNIFORM	DEVELOPMENT OF POLYESTER/WOOL UNIFORM FABRIC WITH IMPROVED DURABILITY AND APPEARANCE	204039/051
UNSTEADY	A STUDY OF THE UNSTEADY FLOW OVER CONCAVE CONIC MODELS AT MACH 15	204113/074
URANIUM	MANUFACTURING METHODS FOR 30MM DEPLETED URANIUM PENETRATORS	203449/033
VACUUM	MANUFACTURING METHODS FOR LOW EMISSION GRID COATINGS FOR BARIUM ACTIVATED CATHODE VACUUM TUBES	203455/033
VAPOR	CHEMICAL VAPOR DEPOSITION OF CHALCOGENIDE SEMICONDUCTORS	204098/029
VAPOR	CHEMICAL VAPOR DEPOSITION OF CADMIUM TELLURIDE	203682/028
VAPOR	CHEMICAL VAPOR DEPOSITION OF MULTISPECTRAL DOMES	203805/026
VEHICLE	REENTRY VEHICLE NOSETIP STRESS ANALYSIS	204125/072
VISCOELASTIC	ACCELERATED CHARACTERIZATION OF FIBER/EPOXY COMPOSITES PT I VISCOELASTIC METHODS	203433/052



VISCOSITIES	DETERMINATION OF CHANGES IN LUBRICANT VISCOSITIES AT HIGH PRESSURES AND TEMPERATURES	203255/047
VOID-GROWTH	DEFORMATION MODE OF VOID-GROWTH AND COALESCENCE IN THE PROCESS OF DUCTILE FRACTURE	203896/017
VULNERABILITY/S	ADVANCED DEVELOPMENT ON VULNERABILITY/SURVIVABILITY OF ADVANCED COMPOSITE STRUCTURES	069611/002
WALL	EX DEV OF HYPERSONIC HEAT TRANSFER AND THERMOCHEMICAL ABLATION OF ADV MATLS NOSETIP TEST DATA EVAL AND ROUGH WALL TRANSITION	203847/069
WATER	WATER DROP/BOW SHOCK INTERACTIONS	204094/018
WATER	SHOCK LAYER SHATTERING OF WATER DROPS AND ICE CRYSTALS IN REENTRY	203843/059
WATER	WATER BASE COATINGS	203416/049
WAVEFORMS	ADAPTIVE NONLINEAR SIGNAL PROCESSING FOR CHARACTERIZATION OF ULTRASONIC NDE WAVEFORMS TASK I INFERENCE OF FLATBOTTOM HOLE SIZE	203736/012
WEAR	PERFORMANCE OF LUBRICANTS OILS AND GREASES IN WEAR TESTS AND COMPACT MATERIALS IN BALL BEARINGS	203570/055
WELD	EXPLORATORY DEVELOPMENT OF WELD QUALITY DEFINITION	203801/068
WELDED	PLANETARY BALL SWAGING OF WELDED TITANIUM ALLOY TUBING	067738/031
WINDOW	FLUORIDE WINDOW MATERIALS FOR USE AS LASER WINDOWS IN THE 2 TO 6 UM SPECTRAL REGION	203898/028
WINDOW	PROCEEDINGS OF THE FOURTH ANNUAL CONFERENCE ON INFRARED LASER WINDOW	204097/028
WINDOW	THERMAL ELECTRICAL AND PHYSICAL PROPERTY MEASUREMENTS OF LASER WINDOW MATERIALS	201819/026
WINDOWS	DEVELOPMENT OF GALLIUM ARSENIDE FOR INFRARED WINDOWS	203821/027
WINDOWS	EXPLORATORY DEVELOPMENT ON THE FEASIBILITY AND RECOMMENDATION FOR NOI OF IR WINDOWS	203345/022

WINDOWS	PROTECTIVE-ANTIREFLECTIVE THIN FILMS FOR POLYCRYSTALLINE ZINC SELENIDE AND ALKALI HALIDE LASER WINDOWS	203173/025
WINDOWS	HALIDE MATERIAL PROCESSING FOR HIGH-POWER INFRARED LASER WINDOWS	203994/030
WINDOWS	HARDENED CVD ZINC SELENIDE FOR FLIR WINDOWS	204037/030
WINDOWS	FLUORIDE WINDOW MATERIALS FOR USE AS LASER WINDOWS IN THE 2 TO 6 UM SPECTRAL REGION	203898/028
WING	F-15 COMPOSITE WING VOL I DEVELOPMENT AND TEST RESULTS	069613/002
WING	F-15 COMPOSITE WING VOL II DEVELOPMENT AND TEST RESULTS	069613/002
WIRE	PLATED WIRE MASS MEMORY ARRAY MANUFACTURING METHODS	203884/032
WIRES	EXPERIMENTAL HYSTERETIC LOSS FOR A SERIES OF SUPERCONDUCTING FILAMENTARY NbTi WIRES AND A FIELD DEPENDENT CRITICAL STATE MODEL	204035/024
WOVEN	THERMAL RESPONSE OF WOVEN AND KNITTED FABRICS IN JP-4 FUEL FIRE ENVIRONMENT	204134/057
WOVEN	MANUFACTURING PROCESS FOR THE DENSIFICATION OF COMPLEX SHAPED WOVEN COMPOSITE PREFORMS	203848/037
ZINC	PROTECTIVE-ANTIREFLECTIVE THIN FILMS FOR POLYCRYSTALLINE ZINC SELENIDE AND ALKALI HALIDE LASER WINDOWS	203173/025
ZINC	ZINC ION IMPLANTATION OF SULFUR-DOPED GALLIUM PHOSPHIDE	203626/029
ZINC	HARDENED CVD ZINC SELENIDE FOR FLIR WINDOWS	204037/030
ZR-MOLDED	INFLUENCE OF IRON AND SILICON CONTENT ON THE TENSILE PROPERTIES OF 7X75 AND ZR-MOLDED 7X75 ALUMINUM PLATE	204007/019
0.050-INCH	EX OF STAT FATIGUE CHARA OF 0.063-INCH MILL-ANNEALED TI-6AL-4V SHEET AND 0.050-INCH HEAT TREATED 17-7 PH STEEL SHEET UNDER SIM F BY F LOADING	202168/008

# AD NUMBER INDEX

AD 919 288 L . . . . .	31
AD A 004 200 . . . . .	47
AD A 004 843 . . . . .	46
AD A 005 701 . . . . .	6
AD A 007 851 . . . . .	49
AD A 007 852 . . . . .	22
AD A 008 529 . . . . .	68
AD A 008 532 . . . . .	8
AD A 008 781 . . . . .	6
AD A 008 782 . . . . .	24
AD A 008 783 . . . . .	25
AD A 009 172 . . . . .	10
AD A 009 515 . . . . .	49
AD A 010 425 . . . . .	66
AD A 011 645 . . . . .	52
AD A 011 647 . . . . .	7
AD A 011 717 . . . . .	8
AD A 011 748 . . . . .	29
AD A 011 779 . . . . .	23
AD A 013 069 . . . . .	29
AD A 013 166 . . . . .	66
AD A 013 877 . . . . .	71
AD A 013 878 . . . . .	27
AD A 013 879 . . . . .	68
AD A 013 880 . . . . .	8
AD A 013 881 . . . . .	12
AD A 013 914 . . . . .	1



# AD NUMBER INDEX (CONTINUED)

AD A 013 915 . . . . .	11
AD A 014 266 . . . . .	52
AD A 014 342 . . . . .	5
AD A 014 352 . . . . .	9
AD A 014 353 . . . . .	69
AD A 014 359 . . . . .	5
AD A 014 360 . . . . .	26
AD A 014 361 . . . . .	6
AD A 014 362 . . . . .	26
AD A 014 363 . . . . .	67
AD A 014 364 . . . . .	35
AD A 014 795 . . . . .	7
AD A 014 808 . . . . .	51
AD A 014 809 . . . . .	27
AD A 015 001 . . . . .	10
AD A 015 002 . . . . .	10
AD A 015 727 . . . . .	53
AD A 015 728 . . . . .	14
AD A 015 729 . . . . .	15
AD A 015 730 . . . . .	71
AD A 015 802 . . . . .	51
AD A 015 831 . . . . .	12
AD A 015 860 . . . . .	14
AD A 015 894 . . . . .	12
AD A 016 473 . . . . .	17
AD A 016 474 . . . . .	51

# AD NUMBER INDEX (CONTINUED)

AD A 016 475 . . . . .	53
AD A 016 525 . . . . .	59
AD A 016 783 . . . . .	70
AD A 017 848 . . . . .	72
AD A 017 860 . . . . .	1
AD A 018 059 . . . . .	19
AD A 018 127 . . . . .	11
AD A 018 128 . . . . .	24
AD A 018 159 . . . . .	73
AD A 018 244 . . . . .	72
AD A 018 635 . . . . .	15
AD A 018 636 . . . . .	62
AD A 018 670 . . . . .	18
AD A 018 682 . . . . .	30
AD A 018 745 . . . . .	3
AD A 018 805 . . . . .	75
AD A 018 861 . . . . .	70
AD A 018 886 . . . . .	70
AD A 019 412 . . . . .	74
AD A 019 452 . . . . .	27
AD A 019 453 . . . . .	60
AD A 019 454 . . . . .	1
AD A 019 518 . . . . .	17
AD A 019 750 . . . . .	16
AD A 019 781 . . . . .	74
AD A 020 021 . . . . .	18

# AD NUMBER INDEX (CONTINUED)

AD A 020 076 . . . . .	20
AD A 020 083 . . . . .	19
AD A 020 283 . . . . .	16
AD A 020 322 . . . . .	20
AD B 000 589 L . . . . .	45
AD B 000 591 L . . . . .	45
AD B 000 726 L . . . . .	43
AD B 000 946 L . . . . .	44
AD B 001 047 L . . . . .	43
AD B 001 110 L . . . . .	31
AD B 001 146 L . . . . .	42
AD B 001 297 L . . . . .	46
AD B 001 433 L . . . . .	43
AD B 001 615 L . . . . .	67
AD B 001 643 L . . . . .	48
AD B 001 796 L . . . . .	22
AD B 001 822 L . . . . .	47
AD B 001 823 L . . . . .	48
AD B 001 862 L . . . . .	53
AD B 002 538 L . . . . .	65
AD B 002 787 L . . . . .	42
AD B 002 921 L . . . . .	66
AD B 002 936 L . . . . .	65
AD B 003 573 L . . . . .	50
AD B 004 218 L . . . . .	24



# AD NUMBER INDEX (CONTINUED)

AD B 004 283 L . . . . .	49
AD B 004 689 L . . . . .	2
AD B 005 585 L . . . . .	9
AD B 005 700 L . . . . .	50
AD B 005 923 L . . . . .	71
AD B 006 264 L . . . . .	57
AD B 006 394 L . . . . .	56
AD B 006 439 L . . . . .	65
AD B 006 648 L . . . . .	57
AD B 006 811 L . . . . .	36
AD B 006 836 L . . . . .	59
AD B 006 837 L . . . . .	36
AD B 006 859 L . . . . .	60
AD B 006 891 L . . . . .	37
AD B 006 906 L . . . . .	2
AD B 006 928 L . . . . .	17
AD B 007 238 L . . . . .	28
AD B 007 239 L . . . . .	48
AD B 007 253 L . . . . .	55
AD B 007 429 L . . . . .	62
AD B 007 440 L . . . . .	41
AD B 007 656 L . . . . .	41
AD B 007 692 L . . . . .	60
AD B 007 909 L . . . . .	61
AD B 007 942 L . . . . .	73
AD B 008 032 L . . . . .	52

# AD NUMBER INDEX (CONTINUED)

AD B 008 163 L . . . . .	65
AD B 008 167 L . . . . .	28
AD B 008 197 L . . . . .	57
AD B 008 267 L . . . . .	63
AD B 008 529 L . . . . .	38
AD B 008 582 L . . . . .	39
AD B 008 691 L . . . . .	40
AD B 008 705 L . . . . .	63
AD B 008 862 L . . . . .	39
AD B 008 937 L . . . . .	62
MCIC-HB-06 . . . . .	76

# AFML REPORT NUMBER INDEX

AFML-TR-70-278, Pt. V -----	41
AFML-TR-71-2 -----	41
AFML-TR-71-24, Pt. IV -----	42
AFML-TR-72-102, Pt. III -----	4
AFML-TR-72-142, Pt. III -----	42
AFML-TR-72-179, Pt. III -----	42
AFML-TR-72-191, Pt. III -----	43
AFML-TR-72-223, Pt. III -----	43
AFML-TR-72-229, Pt. III -----	43
AFML-TR-72-290 -----	44
AFML-TR-73-90, Pt. II -----	44
AFML-TR-73-119, Pt. II -----	45
AFML-TR-73-147, Pt. II -----	45
AFML-TR-73-147, Pt. III -----	45
AFML-TR-73-152 -----	2
AFML-TR-73-171, Pt. II -----	46
AFML-TR-73-172 -----	4
AFML-TR-73-198 -----	31
AFML-TR-73-199, Pt. II -----	46
AFML-TR-73-242, Pt. II -----	46
AFML-TR-73-247, Vol. II -----	4
AFML-TR-73-275 -----	47
AFML-TR-73-280 -----	47
AFML-TR-74-39, Supp. II -----	65
AFML-TR-74-195 -----	47
AFML-TR-74-196, Pt. I -----	48



# AFML REPORT NUMBER INDEX (CONTINUED)

AFML-TR-74-196, Pt. II -----	48
AFML-TR-74-198 -----	5
AFML-TR-74-199 -----	48
AFML-TR-74-200 -----	31
AFML-TR-74-201, Pt. I -----	49
AFML-TR-74-202 -----	31
AFML-TR-74-203 -----	5
AFML-TR-74-207 -----	65
AFML-TR-74-208, Pt. I -----	49
AFML-TR-74-214 -----	6
AFML-TR-74-215 -----	6
AFML-TR-74-216 -----	32
AFML-TR-74-218 -----	49
AFML-TR-74-222 -----	50
AFML-TR-74-223 -----	22
AFML-TR-74-224 -----	6
AFML-TR-74-228 -----	32
AFML-TR-74-229 -----	65
AFML-TR-74-230 -----	50
AFML-TR-74-232 -----	65
AFML-TR-74-236 -----	7
AFML-TR-74-239 -----	33
AFML-TR-74-241 -----	7
AFML-TR-74-243 -----	51
AFML-TR-74-244 -----	33
AFML-TR-74-245 -----	51

# AFML REPORT NUMBER INDEX (CONTINUED)

AFML-TR-74-246	33
AFML-TR-74-247	51
AFML-TR-74-248, Pt. I	52
AFML-TR-74-249	52
AFML-TR-74-252	7
AFML-TR-74-254	66
AFML-TR-74-255	8
AFML-TR-74-256, Pt. I	52
AFML-TR-74-257	1
AFML-TR-74-259	66
AFML-TR-74-260	53
AFML-TR-74-262	66
AFML-TR-74-265	8
AFML-TR-74-266	67
AFML-TR-74-268	22
AFML-TR-74-269	8
AFML-TR-74-271	67
AFML-TR-74-273	9
AFML-TR-74-274	23
AFML-TR-74-275	34
AFML-TR-74-276	9
AFML-TR-74-277	23
AFML-TR-74-278	53
AFML-TR-74-279	53
AFML-TR-74-280	10
AFML-TR-74-281	24
AFML-TR-74-282	10

# AFML REPORT NUMBER INDEX (CONTINUED)

AFML-TR-74-283	10
AFML-TR-75-1	11
AFML-TR-75-2	11
AFML-TR-75-3	68
AFML-TR-75-4, Vol. I & II	34
AFML-TR-75-5	34
AFML-TR-75-6	35
AFML-TR-75-7	68
AFML-TR-75-9	12
AFML-TR-75-10	24
AFML-TR-75-11	54
AFML-TR-75-12	35
AFML-TR-75-14	68
AFML-TR-75-15	24
AFML-TR-75-16	12
AFML-TR-75-17	54
AFML-TR-75-18	25
AFML-TR-75-19, Pt. I	55
AFML-TR-75-20	69
AFML-TR-75-21	25
AFML-TR-75-23	26
AFML-TR-75-24	12
AFML-TR-75-25, Vol. I	69
AFML-TR-75-25, Vol. II	70
AFML-TR-75-27	26
AFML-TR-75-28	26
AFML-TR-75-29	36



# AFML REPORT NUMBER INDEX (CONTINUED)

AFML-TR-75-30	13
AFML-TR-75-32	55
AFML-TR-75-34	27
AFML-TR-75-36	36
AFML-TR-75-37, Vol. I, II, & III	70
AFML-TR-75-38, Pt. I	55
AFML-TR-75-41, Vol. I & II	13
AFML-TR-75-42, Vol. II	70
AFML-TR-75-43	14
AFML-TR-75-44	36
AFML-TR-75-45	71
AFML-TR-75-48	56
AFML-TR-75-49	27
AFML-TR-75-50	14
AFML-TR-75-51, Vol. I	2
AFML-TR-75-52	15
AFML-TR-75-53	56
AFML-TR-75-54	15
AFML-TR-75-57	15
AFML-TR-75-58	71
AFML-TR-75-59	57
AFML-TR-75-60	16
AFML-TR-75-61	57
AFML-TR-75-62	37
AFML-TR-75-64	57
AFML-TR-75-65	71

# AFML REPORT NUMBER INDEX (CONTINUED)

AFML-TR-75-66	27
AFML-TR-75-68	28
AFML-TR-75-69	58
AFML-TR-75-70, Pt. I	58
AFML-TR-75-71	59
AFML-TR-75-72	59
AFML-TR-75-73	28
AFML-TR-75-75	1
AFML-TR-75-76	72
AFML-TR-75-77	59
AFML-TR-75-78, Vol. I & II	2
AFML-TR-75-79	28
AFML-TR-75-83	60
AFML-TR-75-84	16
AFML-TR-75-85, Pt. I	60
AFML-TR-75-86	60
AFML-TR-75-87	29
AFML-TR-75-89	29
AFML-TR-75-90	61
AFML-TR-75-91	29
AFML-TR-75-95	17
AFML-TR-75-97	72
AFML-TR-75-98	61
AFML-TR-75-100	17
AFML-TR-75-101	17
AFML-TR-75-102	37

# AFML REPORT NUMBER INDEX (CONTINUED)

AFML-TR-75-103	62
AFML-TR-75-104	30
AFML-TR-75-105	18
AFML-TR-75-108	37
AFML-TR-75-110	38
AFML-TR-75-111	38
AFML-TR-75-113	3
AFML-TR-75-114	38
AFML-TR-75-115	39
AFML-TR-75-117	73
AFML-TR-75-119	18
AFML-TR-75-121	18
AFML-TR-75-122	62
AFML-TR-75-123	1
AFML-TR-75-125	73
AFML-TR-75-128	62
AFML-TR-75-136	73
AFML-TR-75-137	74
AFML-TR-75-138	74
AFML-TR-75-139	75
AFML-TR-75-140	19
AFML-TR-75-142	30
AFML-TR-75-143	19
AFML-TR-75-144	20
AFML-TR-75-145	39
AFML-TR-75-146	63



AFML REPORT NUMBER INDEX (CONTINUED)

AFML-TR-75-150	-----	40
AFML-TR-75-155	-----	63
AFML-TR-75-158	-----	75
AFML-TR-75-159	-----	76
AFML-TR-75-165	-----	63
AFML-TR-75-168	-----	20
AFML-TR-75-171	-----	20
AFML-TR-75-174	-----	40

# CONTRACTOR INDEX

ADAPTRONICS, INC. . . . .	12
AEROTHERM/ACUREX CORP. . . . .	42, 46, 65
AIR FORCE INSTITUTE OF TECHNOLOGY . . . . .	10
AMERICAN CYANAMID CO. . . . .	25
AMOCO OIL CO. . . . .	42
AVCO SYSTEMS DIVISION . . . . .	36, 43, 52, 59, 63, 69, 70
BATTELLE COLUMBUS LABORATORIES . . . . .	33, 46, 55, 71, 72
BOEING COMMERCIAL AIRPLANE CO. . . . .	7, 8, 40, 68, 75
BOWMAR RESEARCH & DEVELOPMENT DIV., CANADA . . . . .	23
CANADA SUPERCONDUCTOR & CRYOGENICS CO., LTD. . . . .	26
CARNEGIE-MELLON UNIVERSITY . . . . .	41
CELANESE CORPORATION . . . . .	36
CLEMSON UNIVERSITY . . . . .	8
COLT INDUSTRIES/CRUCIBLE, INC. . . . .	13
DETROIT DIESEL ALLISON DIVISION . . . . .	40
DOW CORNING CORPORATION . . . . .	41, 51
FABRIC RESEARCH LABORATORIES . . . . .	59
GENERAL ELECTRIC CO. . . . .	22, 34, 36, 46
GENERAL DYNAMICS . . . . .	2, 6, 33
GEORGE WASHINGTON UNIVERSITY . . . . .	5
GEORGIA INSTITUTE OF TECHNOLOGY . . . . .	61
GRUMMAN AEROSPACE . . . . .	39, 68
HARWELL INDUSTRIAL RESEARCH . . . . .	10
HONEYWELL, INC. . . . .	30, 63
HUGHES AIRCRAFT CO. . . . .	31, 34, 57, 61
HUGHES RESEARCH LABORATORIES . . . . .	22, 25, 28

# CONTRACTOR INDEX (CONTINUED)

ILLINOIS INSTITUTE OF TECHNOLOGY RESEARCH INSTITUTE . . . .	67
ISOMET CORPORATION . . . . .	27
LEHIGH UNIVERSITY . . . . .	49
LOCKHEED-GEORGIA . . . . .	38
MASSACHUSETTS INSTITUTE OF TECHNOLOGY . . . . .	3, 12, 29
MBP CORPORATION . . . . .	35
MCDONNELL DOUGLAS AIRCRAFT CORP. . . . .	2, 37, 49, 58, 67, 76
MIDWEST RESEARCH INSTITUTE . . . . .	9, 45, 47, 55
MONSANTO RESEARCH CORPORATION . . . . .	51
NEW HAMPSHIRE BALL BEARINGS . . . . .	33
NORTHROP CORPORATION . . . . .	14, 39, 58
NUCLEAR METALS, INC. . . . .	12, 31
OHIO STATE UNIVERSITY . . . . .	4
OLIN CORPORATION . . . . .	57
OREGON GRADUATE CENTER . . . . .	16
PARKER HANNIFIN CORPORATION . . . . .	44
PCR, INC. . . . .	43, 60, 62
PENNSYLVANIA STATE UNIVERSITY . . . . .	49
PHILCO-FORD CORP. . . . .	65
POLYTECHNIC INSTITUTE OF NEW YORK . . . . .	4, 17
PRATT & WHITNEY AIRCRAFT . . . . .	34
PROTOTYPE DEVELOPMENT ASSOCIATES, INC. . . . .	65
RAYTHEON CO. . . . .	26, 28, 30, 32, 38
REYNOLDS METALS CO. . . . .	4
RMI CO. . . . .	8
ROCKWELL INTERNATIONAL CORPORATION . . . . .	35, 36, 37
SIKORSKY AIRCRAFT . . . . .	55



# CONTRACTOR INDEX (CONTINUED)

SOUTHERN METHODIST UNIVERSITY . . . . .	66
SOUTHERN RESEARCH INSTITUTE . . . . .	66, 67, 73
SPERRY UNIVAC . . . . .	32
STANFORD UNIVERSITY . . . . .	22
TELEDYNE TITANIUM . . . . .	37
TEXAS INSTRUMENTS, INC. . . . .	27, 31
TRW SYSTEMS . . . . .	42, 62
TYCO LABORATORIES . . . . .	42
UNION CARBIDE CORPORATION . . . . .	45, 47
UNITED AIRCRAFT CORPORATION . . . . .	48
UNIVERSAL TECHNOLOGIES CORPORATION . . . . .	11, 48
UNIVERSITY OF ARIZONA . . . . .	60
UNIVERSITY OF CALIFORNIA . . . . .	17, 18
UNIVERSITY OF CINCINNATI . . . . .	9, 20
UNIVERSITY OF DAYTON . . . . .	18, 20, 24, 26, 28, 69, 74
UNIVERSITY OF FLORIDA . . . . .	50
UNIVERSITY OF MANITOBA . . . . .	23
UNIVERSITY OF ROCHESTER . . . . .	17
VARIAN ASSOCIATES . . . . .	33
VIRGINIA POLYTECHNIC INSTITUTE & STATE UNIVERSITY . . . . .	52
VON KARMAN INSTITUTE FOR FLUID DYNAMICS . . . . .	74, 75
WASHINGTON UNIVERSITY . . . . .	6
WEILER RESEARCH, INC. . . . .	70
WESTINGHOUSE ELECTRIC CORPORATION . . . . .	24, 72
WRIGHT STATE UNIVERSITY . . . . .	19

# CONTRACT NUMBER INDEX

AFOSR-73-2523A . . . . .	10
AFOSR-72-2227 . . . . .	74, 75
F33615-69-C-1258 . . . . .	4
F33615-70-C-1131 . . . . .	3
F33615-70-C-1058 . . . . .	41
F33615-70-C-1279 . . . . .	31
F33615-71-C-1215 . . . . .	65
F33615-71-C-1266 . . . . .	13
F33615-71-C-1374 . . . . .	12
F33615-71-C-1385 . . . . .	16
F33615-71-C-1406 . . . . .	43
F33615-71-C-1414 . . . . .	2
F33615-71-C-1439 . . . . .	42
F33615-71-C-1468 . . . . .	57
F33615-71-C-1490 . . . . .	42
F33615-71-C-1525 . . . . .	13
F33615-71-C-1536 . . . . .	2
F33615-71-C-1538 . . . . .	45
F33615-71-C-1659 . . . . .	43
F33615-71-C-1944 . . . . .	31
F33615-71-C-1947 . . . . .	32
F33615-72-C-1126 . . . . .	37
F33615-72-C-1148 . . . . .	36
F33615-72-C-1178 . . . . .	34
F33615-72-C-1243 . . . . .	35
F33615-72-C-1257 . . . . .	26

# CONTRACT NUMBER INDEX (CONTINUED)

F33615-72-C-1328 . . . . .	33
F33615-72-C-1333 . . . . .	50
F33615-72-C-1374 . . . . .	55
F33615-72-C-1449 . . . . .	34
F33615-72-C-1466 . . . . .	23
F33615-72-C-1523 . . . . .	46
F33615-72-C-1529 . . . . .	4, 17
F33615-72-C-1591 . . . . .	67
F33615-72-C-1594 . . . . .	51
F33615-72-C-1627 . . . . .	45
F33615-72-C-1645 . . . . .	17
F33615-72-C-1653 . . . . .	33
F33615-72-C-1665 . . . . .	37
F33615-72-C-1705 . . . . .	6
F33615-72-C-1774 . . . . .	46
F33615-72-C-1803 . . . . .	69, 70
F33615-72-C-1822 . . . . .	61
F33615-72-C-1835 . . . . .	20
F33615-72-C-1837 . . . . .	34
F33615-72-C-1939 . . . . .	47
F33615-72-C-2003 . . . . .	8
F33615-72-C-2011 . . . . .	22
F33615-72-C-2019 . . . . .	30
F33615-72-C-2031 . . . . .	55
F33615-72-C-2039 . . . . .	68
F33615-72-C-2111 . . . . .	52



# CONTRACT NUMBER INDEX (CONTINUED)

F33615-72-C-2113 . . . . .	11
F33615-72-C-2202 . . . . .	7
F33615-73-C-1073 . . . . .	26
F33615-73-C-5002 . . . . .	32
F33615-73-C-5005 . . . . .	37
F33615-73-C-5006 . . . . .	36
F33615-73-C-5017 . . . . .	35
F33615-73-C-5018 . . . . .	38
F33615-73-C-5026 . . . . .	6
F33615-73-C-5027 . . . . .	18
F33615-73-C-5036 . . . . .	39
F33615-73-C-5042 . . . . .	62
F33615-73-C-5044 . . . . .	25
F33615-73-C-5053 . . . . .	71
F33615-73-C-5058 . . . . .	27
F33615-73-C-5060 . . . . .	23
F33615-73-C-5062 . . . . .	61
F33615-73-C-5069 . . . . .	47
F33615-73-C-5073 . . . . .	72
F33615-73-C-5075 . . . . .	28
F33615-73-C-5079 . . . . .	51
F33615-73-C-5084 . . . . .	9
F33615-73-C-5087 . . . . .	46
F33615-73-C-5090 . . . . .	48
F33615-73-C-5091 . . . . .	49
F33615-73-C-5092 . . . . .	12
F33615-73-C-5096 . . . . .	71

# CONTRACT NUMBER INDEX (CONTINUED)

F33615-73-C-5097 . . . . .	20
F33615-73-C-5100 . . . . .	18
F33615-73-C-5101 . . . . .	49
F33615-73-C-5104 . . . . .	2
F33615-73-C-5106 . . . . .	8
F33615-73-C-5107 . . . . .	72
F33615-73-C-5109 . . . . .	73
F33615-73-C-5118 . . . . .	66
F33615-73-C-5121 . . . . .	9
F33615-73-C-5122 . . . . .	44
F33615-73-C-5124 . . . . .	66
F33615-73-C-5125 . . . . .	67
F33615-73-C-5128 . . . . .	52
F33615-73-C-5129 . . . . .	22
F33615-73-C-5142 . . . . .	65
F33615-73-C-5160 . . . . .	31
F33615-73-C-5161 . . . . .	14
F33615-73-C-5166 . . . . .	29
F33615-73-C-5167 . . . . .	28
F33615-73-C-5171 . . . . .	75
F33615-73-C-5179 . . . . .	49
F33615-74-C-0148 . . . . .	70
F33615-74-C-1066 . . . . .	27
F33615-74-C-5001 . . . . .	24
F33615-74-C-5003 . . . . .	5
F33615-74-C-5004 . . . . .	76
F33615-74-C-5007 . . . . .	40

# CONTRACT NUMBER INDEX (CONTINUED)

F33615-74-C-5012 . . . . .	56
F33615-74-C-5016 . . . . .	43
F33615-74-C-5017 . . . . .	62
F33615-74-C-5021 . . . . .	25
F33615-74-C-5024 . . . . .	69, 72
F33615-74-C-5026 . . . . .	56
F33615-74-C-5027 . . . . .	58
F33615-74-C-5029 . . . . .	73
F33615-74-C-5032 . . . . .	60
F33615-74-C-5046 . . . . .	41
F33615-74-C-5048 . . . . .	58
F33615-74-C-5051 . . . . .	57
F33615-74-C-5060 . . . . .	4
F33615-74-C-5061 . . . . .	65
F33615-74-C-5064 . . . . .	17
F33615-74-C-5065 . . . . .	68
F33615-74-C-5070 . . . . .	63
F33615-74-C-5081 . . . . .	67
F33615-74-C-5086 . . . . .	38
F33615-74-C-5109 . . . . .	33
F33615-74-C-5113 . . . . .	60
F33615-74-C-5117 . . . . .	59
F33615-74-C-5122 . . . . .	12
F33615-74-C-5125 . . . . .	22
F33615-74-C-5136 . . . . .	36
F33615-74-C-5143 . . . . .	59



CONTRACT NUMBER INDEX (CONTINUED)

F33615-74-C-5145 . . . . .	30
F33615-74-C-5149 . . . . .	63
F33615-74-C-5150 . . . . .	38
F33615-74-C-5153 . . . . .	39
F33615-75-C-5011 . . . . .	28
F33615-75-C-5207 . . . . .	19

AD-A038 676

AIR FORCE MATERIALS LAB WRIGHT-PATTERSON AFB OHIO  
ABSTRACTS OF AIR FORCE MATERIALS LABORATORY REPORTS. (U)  
SEP 76 T G PURNHAGEN  
AFML-TR-76-111

F/G 5/2

UNCLASSIFIED

3 OF 3

AD  
A038 676

SUPPLEMENTARY

INFORMATION

END  
DATE  
FILMED

1 - 78

DDC

NL

**SUPPLEMENTARY**

**INFORMATION**

AD-A038 676

CORRECTION

Page 46 - 2nd abstract- to be corrected to AFML-TR-73-190-pt.2

DDC-TCA  
19 Oct 77